On the so-called "Kriva Reka type" of Ludogorie chert: a petrographic perspective from the Upper Palaeolithic sites in the Giurgiu-Călăraşi area (southern Romania)

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Abstract: *The Southern Carpathians and the Balkan Mountains define a broad physiographic area, placed at the centre of current debates on the emergence of the earliest Upper Palaeolithic and the Aurignacian technocomplex, the migration and dispersal routes of Anatomically Modern Humans in Europe, and the pre-Neolithic and the neolithization of the Balkan area. In this archaeological context and state of research, the Upper Palaeolithic sites from the Lower Danube Valley represent a relevant piece in the jigsaw puzzle of past human land use and mobility patterns. The aim of this article is to investigate the similarity between intraclastic-bioclastic cherts from Giurgiu-Călăraşi area and "Kriva Reka" type of Ludogorie chert from NE Bulgaria, by focusing on their macroscopic and microscopic traits and their geological contexts. The distribution of eluvial and primary deposits of Ludogorie chert types from NE Bulgaria reflects the sedimentary facies belts of the Lower Cretaceous Sea. Also, the alluvial deposits reveal the role played by rivers in the erosion, transport, and redeposition further and further away of the Ludogorie cherts, thus generating an extended area abundant in such materials. The geological distribution of Kriva Reka type similar cherts in Romania was confirmed in alluvial deposits around Giurgiu (Frăteşti Formation, Lower Pleistocene, and Danube's lower terrace deposits, Upper Pleistocene). The archaeological distribution was confirmed in the Upper Palaeolithic open-air sites from Giurgiu-Malu Roşu, Slobozia-Râpa Bulgarilor, and Nicolae Bălcescu-La Vii. Their use by Boian and Gumelniţa Neolithic communities from southern Romania suggests a long time exploitation of local available cherts.*

Rezumat: *Carpaţii Meridionali şi Munţii Balcani definesc o arie fiziografică largă, plasată în centrul dezbaterilor curente asupra apariţiei Paleoliticului superior incipient şi a tehnocomplexului aurignacian, asupra rutelor de migraţie şi dispersie în Europa a oamenilor anatomic moderni, şi asupra pre-neoliticului şi neolitizării zonei balcanice. În acest context arheologic şi în stadiul actual al cercetării, siturile aparţinând Paleoliticului superior de pe Valea Dunării inferioare reprezintă o parte importantă în reconstituirea trecutului uman privind utilizarea teritoriului şi a tiparelor de mobilitate. Scopul acestui articol este de a investiga similaritatea dintre silicolitele intraclastic-bioclastice din zona Giurgiu-Călăraşi şi tipul Kriva Reka de silicolit Ludogorie din NE Bulgariei, concentrându-se pe caracteristicile macro- şi microscopice şi pe contextul lor geologic. Investigaţia contextului geologic a pus în evidenţă faptul că distribuţia depozitelor eluviale şi primare ale silicolitelor Ludogorie din NE Bulgariei reflectă zonele de facies sedimentar ale mării din Cretacicul inferior. De asemenea, distribuţia depozitelor aluviale denotă rolul jucat de râuri în eroziunea, transportul şi resedimentarea din ce în ce mai îndepărtată a silicolitelor Ludogorie, generând astfel o largă şi bogată zonă în astfel de materiale silicioase. Distribuţia geologică a silicolitelor similare celor de tip Kriva Reka în România a fost confirmată în depozite aluviale din zona Giurgiu (Formaţiunea de Frăteşti, Pleistocen inferior, şi depozitele de terasă ale Dunării, Pleistocen superior), în timp ce distribuţia arheologică a acestora a fost confirmată în aşezările în aer liber din Paleoliticul superior de la Giurgiu-Malu Roşu, Slobozia-Râpa Bulgarilor şi Nicolae Bălcescu-La Vii. Utilizarea acestora de către comunităţile neolitice de tip Boian şi Gumelniţa din sudul României sugerează exploatarea silicolitelor din surse locale de-a lungul unei lungi perioade de timp.*

Keywords: *intraclastic-bioclastic cherts, Kriva Reka type, Ludogorie chert, microfacies analysis, Upper Palaeolithic, Lower Danube Valley, southern Romania, northeastern Bulgaria.*

Cuvinte cheie: *silicolite intraclastic-bioclastice, tipul Kriva Reka, silicolit Ludogorie, analiză de microfacies, Paleolitic superior, Valea Dunării inferioare, sudul României, nord-estul Bulgariei.*

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◈ 1. Introduction

In the last two decades, world-wide Palaeolithic research has seen a growing body of papers and research projects focused on chert characterization and provenance in variable, more or less regional geographical, geological, and archaeological contexts, mainly employing, beside macroscopic features, petrographic microscopy or geochemical analyses as investigation tools. But this growth/progress is uneven across European countries.

The Southern Carpathians and the Balkan Mountains define a broad physiographic area, placed at the centre of current debates on the emergence of the earliest Upper Palaeolithic and the Aurignacian technocomplex (N. Teyssandier 2006, p. 10-14; N. Sirakov *et alii* 2007; T. Tsanova 2008, p. 215-227; 2012, p. 227-230; T. Tsanova *et alii* 2012, p. 492-495; V. Sitlivy *et alii* 2012, p. 124-127; Ch. Schmidt *et alii* 2013, p. 3741; M. Anghelinu, L. Niţă 2014, p. 173-189; V. Sitlivy *et alii* 2014a, p. 273-274; 2014b, p. 208-210), on the migration and dispersal routes of Anatomically Modern Humans in Europe (J.K. Kozlowski 1979, p. 77-78; N.J. Conard, M. Bolus 2003, p. 333; E. Trinkaus *et alii* 2003a, p. 11235; 2003b, p. 252-253; P. Mellars 2004, p. 463; 2006, p. 933; H. Rougier *et alii* 2007, p. 1169-1170; R. Iovita *et alii* 2013, p. 99; S. Ivanova *et alii* 2012, p. 1-5), but also the pre-Neolithic and the neolithization of the Balkan area (J.K. Kozlowski 2004; E. Marinova, R. Krauss 2014; M. Gurova, C. Bonsall 2014a; 2014b).

Despite these intense debates and the importance of the subjects, we are faced with a rather meagre and uneven archaeological tableau regarding the Palaeolithic findings in the area between the Southern Carpathians, the Danube and up to the Black Sea. The Lower and Middle Palaeolithic sites and findings with secure contexts are rather limited to specific landscapes (the Southern Carpathians caves, Getic plateau, Dobrudja) and missing or very doubtful in the rest of the area (Al. Păunescu 1999, p. 28-33; 2000, p. 40-43; A. Doboş 2008, p. 218-227, fig. 2; R. Iovita *et alii* 2013, p. 103-111). The scattered distribution of Upper Palaeolithic (UP) sites and fortuitous findings (fig. 1) give an incomplete picture about the human occupations for this period. This scattered spatial repartition is partially related to geological conditions during the occupational moments (influencing the settlement patterns of UP humans), but mainly to more recent geological ones (landscape changes during the late Upper Pleistocene and Holocene covering or destroying UP sites) and uneven archaeological research mainly concentrated on cave sites or evident raw material sources (M. Anghelinu, L. Niţă 2014, p. 174).

Added to these, the cultural and chronological contexts of UP sites (Al. Păunescu 1999, p. 33-38; 2000, p. 43-52; Em. Alexandrescu 2009: 19-22; M. Anghelinu, L. Niţă 2014, p. 181-187; A. Tuffreau *et alii* 2014, p. 280-281; R. Dobrescu *et alii* 2015, p. 31) increases the fragmentation of the archaeological landscape and thus its potential for a regional-scale analysis. More so, the basic raw materials identification performed for these UP sites (C.S. Nicolăescu-Plopşor *et alii* 1956, p. 225; Em. Protopopescu-Pache, C.N. Mateescu 1959, p. 13; D. Popescu *et alii* 1961, p. 633; Fl. Mogoşanu, M. Bitiri 1961, p. 219; Fl. Mogoşanu 1964, p. 337; C.N. Mateescu 1970, p. 69; V. Boroneanţ, I. Vlad 1979, p. 26; V. Boroneanţ *et alii* 1983, p. 15; Al. Păunescu 1999, p. 92-93, 93-102, 132, 202-208, 121-124, 215-220, 196-200; M. Cârciumaru *et alii* 2000, p. 51; Al. Păunescu 1999-2000, p. 28, 30; 2000, p. 323) seem to indicate the overwhelming exploitation of local sources, while the provenance of "exotic" materials hasn't been determined or proven consistently. Thus, the suggested raw material supply pattern is one adapted for the local environment and conditions (also related to specific time periods). These restrictions do not imply a lack of communication and circulation paths between UP populations, but additional criteria (consistently applied) should be used to underline those patterns which eluded the past chrono-cultural pursuit (such as raw material supply patterns, raw materials circulation). In the above sketched archaeological context and in current state of research, the UP sites from the Lower Danube Valley (fig. 1) represent a spatially restricted, but relevant piece in the jigsaw puzzle of past human land use and mobility patterns for this area.

Recent developments in petro-archaeological research (M. Gurova, Ch. Nachev 2008; C. Bonsall *et alii* 2010; P. Andreeva *et alii* 2014; Al. Ciornei 2013; Al. Ciornei *et alii* 2014) permit the investigation of potential connections between Romanian chert[1] types from the Lower Danube Valley and those from the northern and north-eastern Bulgaria.

◈ 2. Short overview of the archaeological and research contexts

Despite the constant efforts towards a coherent cultural and chronological evolution model of UP sites from the Lower Danube Valley (Al. Păunescu 2000, p. 43-52; Em. Alexandrescu 1997; 2000; 2009, p. 19-20), their raw material supply strategies and land use can only be discussed isolated and diachronically, given the long time span covered by these sites and the technological and typological differences (A. Tuffreau *et alii* 2014, p. 280-281; M. Anghelinu, L. Niţă 2014, p. 181-185).

The current study is focused on three Upper Palaeolithic open-air sites found within loess and loess-like deposits (A. Conea 1970, p. 64, 65-fig. 11; L. Badea 1997, p. 11; D.C. Jipa 2014, fig. 5) from the Danube’s terraces in Giurgiu-Călăraşi area: Giurgiu-Malu Roşu (GMR), Slobozia-Râpa Bulgarilor (Sl-RB) and Nicolae Bălcescu-La Vii (NB-Vii) (fig. 1, tab. 1).

Sites	Archaeological investigations	Archaeo-logical levels	Absolute dates	Lithic pieces
Giurgiu-Malu Roşu	discovered in 1952 during a field survey by Gh. Rădulescu and M. Ionescu; field survey in 1954 by C. S. Nicolăescu-Plopşor, E. Comşa, Al. Păunescu and P. Diaconu; systematic excavation by Al. Păunescu, Gh. Răduelscu and M. Ionescu (1958-1959, 1960); excavations by Al. Păunescu and Em. Alexandrescu (1992-1996); excavations coordinated by Em. Alexandrescu (1998-2004);	bed AII -1.35-1.50 m	-	40000 to 60000
		bed AI		
		level AIc -1.80-2.25 m	-	
		level AIb -2.25-2.45 m	-	
		level AIa -2.45-2.85 m	21140±120 BP 22790±130 BP	
		sterile -2.90 m	27±3 ka BP	
Slobozia-Râpa Bulgarilor	field survey by Al. Păunescu (1959); excavations by Al. Păunescu and M. Ionescu (1960);	-1.06-1.20 m	-	12
Nicolae Bălcescu-La Vii	excavations by M. Munteanu (1987, 1990, 1993); excavations coordinated by Al. Păunescu and Em. Alexandrescu (1995-1996);	-0.30-0.60 m	-	309

Tab. 1. The Upper Palaeolithic sites from Giurgiu-Călăraşi area.
Aşezările Paleoliticului superior din zona Giurgiu-Călăraşi.

[1] Chert is used here with its general geological meaning encompassing all sedimentary siliceous rocks.

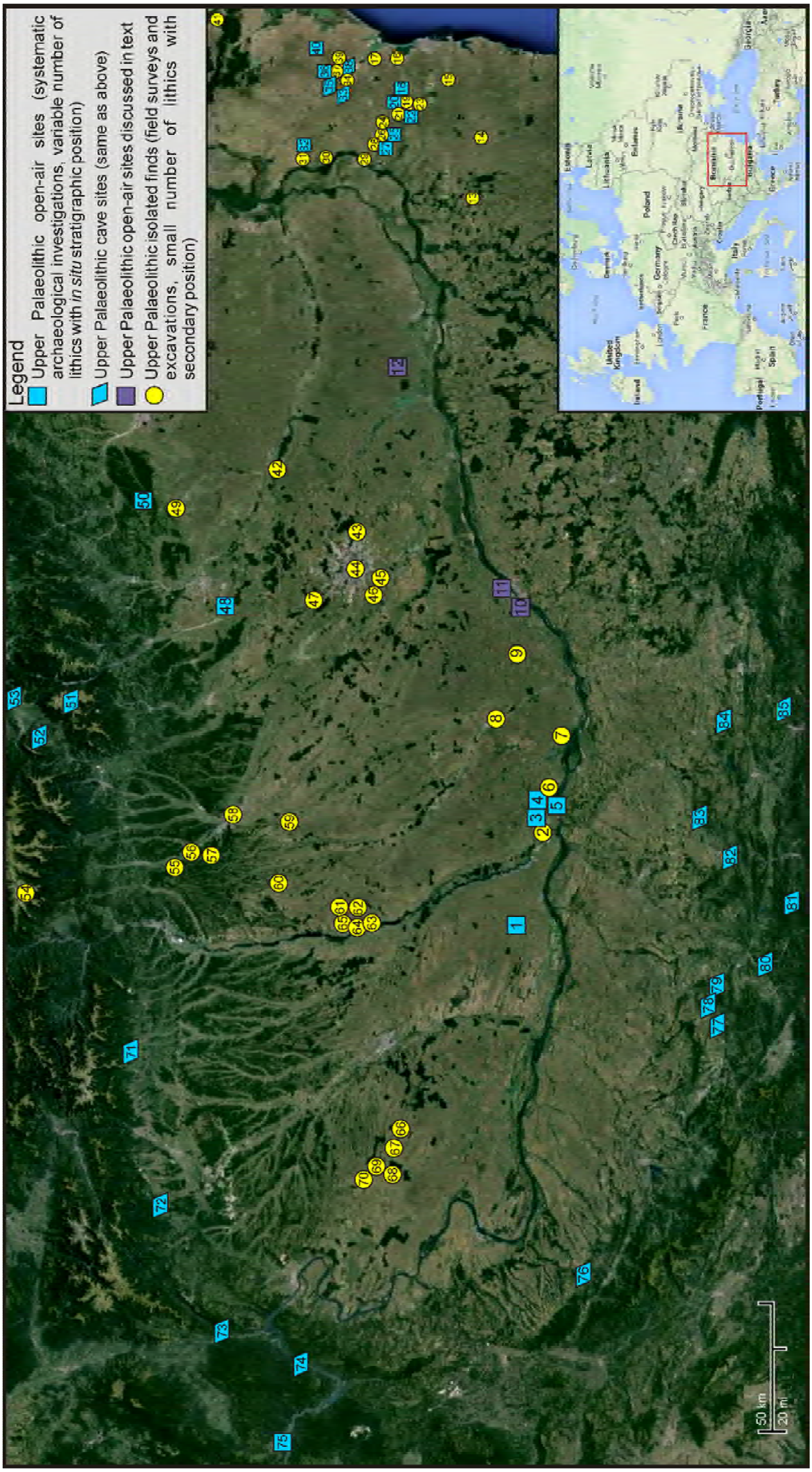
Legend
Upper Palaeolithic open-air sites (systematic archaeological investigations, variable number of lithics with *in situ* stratigraphic position)
Upper Palaeolithic cave sites (same as above)
Upper Palaeolithic open-air sites discussed in text
Upper Palaeolithic isolated finds (field surveys and excavations, small number of lithics with secondary position)
50 km
20 mi

Fig. 1. Upper Palaeolithic sites and isolated discoveries in the area between the Southern Carpathians and the Balkan Mountains (Southern Romania and Northern Bulgaria); sites in Romania were plotted after Al. Păunescu (1999; 2000; 2001); sites from Bulgaria were mapped in accordance with information from N. Džambazov (1981), S. Ivanova, S. Sirakova (1995), T. Tsanova (2006; 2008); map support from https://maps.google.ro. Locations on the map: 1. Vădastra-Măgura Fetelor; 2. Turnu Măgurele-Odaia; 3. Ciuperceni-La Tir; 4. Ciuperceni-La Vii; 5 Poiana-La NE de sat; 6. Traian-La NV de sat; 7 Fântânele-La Tudorcea and Fântânele-La Movilă; 8. Alexandria-Poroschia; 9. Drăghiceanu-Fundul Drăghiceanului; **10. Slobozia-Râpa Bulgarilor; 11. Giurgiu-Malu Roşu; 12. Nicolae Bălcescu-La Vii**; 13. Văleni-Lângă cimitir; 14. Conacu-La VNV de sat; 15. Straja-La dig la Stănişor; 16. Lumina-Pensinsula Punct II; 17. Sibioara-La NNV de livada cu pruni; 18. Castelu-Dealu Castelu Punctul II and Castelu-La Cărămidărie; 19. Castelu-Dealu Castelu Punctul III; 20. Cuza Vodă-Cariera Veche de lângă pădure and Cuza Vodă-Marginea de E a carierei „Caolinul Medgidia"; 21. Cuza Vodă-Cariera Veche; 22. Medgidia-La ESE de Gara Veche; 23. Medgidia-Cariera nouă a Fabricii de Ciment and Medgidia-Curtea uzinei IMUM; 24. Tortoman-La SE de sat; 25. Gherghina-La Cariera veche; 26. Gherghina-Cariera de Humă; 27. Ţibrinu-Malul stâng al lacului Punctul III, Ţibrinu-Malul stâng al lacului Punctul IA and Ţibrinu-La marginea de SE a satului Punctul V; 28. Ţibrinu-Malul stâng al lacului Punctul II, Ţibrinu-Malul stâng al lacului Punctul III, Ţibrinu-Malul stâng al lacului Punctul IIIA, and Ţibrinu-Malul stâng al lacului Punctul IIIB; 29. Seimeni-La Silişte, Seimeni-Fântâna lui Dinu Ciorbaru, and Seimeni-Izlazul lui Gherlan; 30. Topalu-Peştera din carierele de piatră; 32. Tichileşti-La S de Cariera Veche; 32. Tichileşti-La Cariera Veche; 33. Târguşor-Peştera La Adam; 34. Târguşor-La Saivane; 35. Cheia-Peştera Bursucilor and Cheia-Peştera „Cheia la Izvor"; 36. Casian-La 2 km S; 37. Casian-La 2 km SSE; 38. Gura Dobrogei-Peştera „Adăpostul rândunelelor"; 39. Gura Dobrogei-Vatra satului; 40. Tariverde-Pe Islaz and Tariverde-La S de sat; 41. Babadag-La N şi NE; 42. Coşereni; 43. Cernica; 44. Bucureşti-Arhivele Statului; 45. Alunişu-Gherman; 46. Bragadiru; 47. Buftea-Cârna-Măneşti; 48. Târgşoru Vechi-Curtea Domnească; 49. Vadu Săpat-Valea Budureasca; 50. Lapoş-Poiana Roman; 51. Dobreşti-Peştera Mică; 52. Peştera-Moeciu-Peştera Mare (Liliecilor), Peştera-Moeciu-Peştera Mică, and Peştera-Moeciu-Peştera Valea Coacăzii; 53. Râşnov-Peştera Gura Cheii; 54. Arefu-Şaua Serbota; 55. Tutana; 56. Malu Vânăt-Merişani; 57. Drăganu-Olteni; 58. Piteşti; 59. Costeşti-La 1,5 km în avale de podul CFR; 60. Vineţi; 61. Valea Mare; 62. Valea Mare-Recea; 63. Milcovu din Vale; 64. Slatina-Clocociov; 65. Slatina-Cireaşov, 66. Bechet; 67. Cleanov-Pe terasa Desnăţuiului and Cleanov-Dealu Fiera; 68. Suharu; 69. Verbiţa; 70. Gvardiniţa-Buzata; 71. Baia de Fier-Peştera Muierii; 72. Boroşteni-Peştera Cioarei; 73. Băile Herculane-Peştera Hoţilor; 74. Dubova-Peştera lui Climente; 75. Gornea-Dealu Păzărişte and Gornea-Vodneac; 76. Kozarnica; 77. Pešt; 78. Samuillica II; 79. Temnata Doupka; 80. Morovitsa; 81. Topliya; 82. Vasil Levski; 83. Devetaška; 84. Emenskata; 85. Bacho Kiro.

Situri şi descoperiri izolate din Paleoliticul superior în zona dintre Carpaţii Meridionali şi Munţii Balcani.

The study area covers a part of the Muntenia region in southern Romania: the segment of the Lower Danube Valley between East of the Vedea River and East of the Mostiştea Valley, not extending beyond the northern limit of Danube's valley (that is the geomorphologic contact between the Danube's terrace plain and the high plain) and the river's water line. The Danube flows through an asymmetric contact valley between the Romanian Plain (89-95 m absolute altitude) and the Danubian Hilly Plain/Danubian Plain (500 m absolute altitude) (P.V. Coteţ 1969, p. 25-26; Mateescu *et alii* 1969, p. 532; Gh. Niculescu, V. Senecu 1969, p. 40; P.V. Coteţ 1976, p. 96-98; Gr. Posea 2006, p. 92; I. Zagorchev

2009, p. 984-986; K. Stoyanov, Em. Gachev 2012, p. 380). The Romanian side of the Lower Danube Valley gently descends towards the water line and is composed of four terraces (40-20 m to 10-4 m relative elevation) and the floodplain (N. Oncescu 1965, p. 126, 136; P.V. Coteţ 1976, p. 96-98; Gr. Posea 2006, p. 92). The Bulgarian side of the Lower Danube Valley is tilted and formed by cliffs of 50-200 m elevation, with three terraces of 35-15 m relative elevation in the area between Ruse and Silistra (K. Stoyanov, Em. Gachev 2012, p. 380).

GMR is located at the ENE periphery of Giurgiu city (Giurgiu county, southern Romania), on the lower terrace of the Danube. From a technological and typological point of view (Al. Păunescu 2000, p. 277), the lithic assemblages were considered to indicate "very late/evolved Aurignacian" (Al. Păunescu, Em. Alexandrescu 1997a, p. 22; 1997b, p. 26; Al. Păunescu 2000, p. 283) or "Epiaurignacian" cultural traditions (Em. Alexandrescu 2009, p. 9-18), from around 23000 BP (for level AIa) down to 17-16000 BP (level AII). Early archaeological research at GMR site determined flint[2] as the main raw material knapped by Palaeolithic people. C.S. Nicolăescu-Plopşor *et alii* (1956, p. 225) described this flint as being a "bluish-grey colour – more or less darker – coarse granulated, low quality raw material", many of the flakes preserving the "limestone crust, without the slightest trace of rolling". Subsequent archaeological investigations from 1958-1960 and 1992-2004 (Al. Păunescu *et alii* 1962, p. 130; 1964, p. 109; Al. Păunescu, Em. Alexandrescu 1997b, p. 25; Al. Păunescu 2000, p. 276; Em. Alexandrescu 1996-1998, p. 47-48; Em. Alexandrescu, T. Popa 1996-1998, p. 64; Em. Alexandrescu *et alii* 2004, p. 413; 2007, p. 97) pointed out that the "bluish-grey and dark blue coarse granulated flint" (or "greyish flint with blue shades and small whitish speckles"/"silex A" category) represents the main raw material (over 70%), followed subordinately by the "yellowish-brown flint" (or "silex M" category/"Frăteşti type flint"), while other rock types ("fine-grained grey flint with glassy lustre", jasper, siliceous sandstone, quartzite and quartz sandstone, black schist, opal, andesite) were used in "negligible" amounts.

According to Em. Alexandrescu, B. Soare (2009, p. 55-56) chert samples from Malu Roşu site are macroscopically characterized by massive and compact appearance, strongly cemented, elevated hardness, conchoidal fracture, various colours (white, cream, red, grey, dark grey to almost black), waxy to glassy lustre, with a 1 mm thick white crust. The microscopic analysis and X-ray diffraction revealed that the predominant mineral phase is quartz, subordinately followed by chalcedony (as radial aggregates), moganite (rare), and carbonates (calcite, dolomite). These flints contain echinoderm plates, carbonate and/or siliceous foraminifera, and xenomorph opaque material. Based on this petrographic description and correlated with technological features (i.e. large quantity of reduction by-products, chaotic reduction of the material, low amounts of blades and atypical morphology of tools), Em. Alexandrescu, B. Soare (2009, p. 56) concluded, as previously pointed out by C.S. Nicolăescu-Plopşor *et alii* (1956, p. 225), that Malu Roşu cherts are low quality raw materials. This recent petrographic study, oriented towards mineralogy and not primary constituents, lacking any kind of sedimentological implications of the identified microfauna and other constituents, and representing a generalized description, failed to recognize the existence of different types of cherts inside the lithic assemblage.

[2] Flint is used here as translation for "silex" from the Romanian archaeological literature, a term that refers to fine-grained siliceous materials with conchoidal fracture, in many cases including materials other than the Upper Cretaceous material known as flint in other countries.

Sl-RB (Giurgiu county) is located on the same lower terrace of Danube. The lithics in this site are knapped from the same raw materials and have the same technological and typological traits as those from GMR (Al. Păunescu *et alii* 1962, p. 135-138; 1964, p. 109; Al. Păunescu 2000, p. 285-286).

Sites	Raw materials provenance	References
Giurgiu-Malu Roşu	- "Danube's gavels […] rich in flint […] originating in the prebalkan platform, in the Cretaceous deposits" - "in gravel quarries of the Lower Anthropozoic deposits at Daia, Frătești, Bălănoaia, Ghizdaru, with abundant flint pebbles with south Danube origin" - "from the host-rock deposit and the natural openings of such deposits […] South of Danube"	C.S. Nicolăescu-Plopşor *et alii* 1956, p. 225
	- "near the site and that is across the Danube, from the prebalkan platform"	Al. Păunescu *et alii* 1962, p. 130
	"specific to Lower Danube Valley"*	Al. Păunescu, Em. Alexandrescu 1997b, p. 25
	- "somewhere in Danube's minor riverbed from that time" - "in Frătești Gravels"**	Em. Alexandrescu 1996-1998, p. 33, 47-48
	- "alluvial sediments of the terrace they've lived on or from a nearby area"**	Al. Păunescu 2000, p. 57
Nicolae Bălcescu-La Vii	- "from the right side of Danube […] from the Moesian Platform"	Al. Păunescu, Em. Alexandrescu 1997c, p. 62

* The petrographic analysis carried out by Clarissa Papacostea (Al. Păunescu 1970, p. 218-219; Al. Păunescu, Em. Alexandrescu 1997b, p. 25) on a sample of "greyish flint with blue shades and small whitish speckles" revealed that this material has: a microcrystalline spherulitic structure; compact texture; fundamental mass composed of "cryptocrystalline silica represented by equal amounts of crystalline quartz, fibrous chalcedony with fibroradial structure"; "formations with marginal grey tinted opaque appearance"; remnant calcite; partially or completely silicified calcareous organisms (echinoderms plates); sponge spicules preserved in silica (opal-filled axial channel); opal as separated small portions, yellow coloured and isotropic in polarized light.
** A yellowish-brown flint was identified by Al. Păunescu (2000, p. 57) through his field surveys of 1993-1995 in the "Frăteşti Gravels" exposed by modern quarrying activities some 7 to 10 km N and NW from GMR, where he observed "a great quantity of flint and quartzite natural pebbles (whole or broken), of variable sizes and weights". The provenance of the "greyish flint with blue shades and small whitish speckles" has not been established.

Tab. 2. Possible provenance of raw-materials from the Upper Palaeolithic sites.
Provenienţa posibilă a materiilor prime din aşezările Paleoliticului superior.

NB-Vii (Nicolae Bălcescu village, Călăraşi county) is located on the right side of Gălăţui lake, on a lower terrace of Danube. The lithic assemblage is technologically and typologically similar to that of GMR (Al. Păunescu, Em. Alexandrescu 1997c, p. 60-63). The raw material is represented by brown, dark brown and brownish-grey Senonian flint (ca. 95%), and in a very small percentage (5%) by fine-gained brown and grey flint (Al. Păunescu, Em. Alexandrescu 1997c, p. 62).

In spite of some microscopic analyses carried out on samples from GMR (Al. Păunescu 1970, p. 218-219; Al. Păunescu, Em. Alexandrescu 1997b, p. 25; Em. Alexandrescu, B. Soare 2009, p. 55-56), the raw materials provenance was based on the researchers' personal experience with siliceous materials from different areas and limited land surveys. The supply sources with flint for GMR and Sl-RB sites were considered to be either nearby alluvial deposits found on the left side of Danube, or host-rock deposits found in Bulgaria (tab. 2). For NB-Vii site there were no petrographic investigations and no sources sought, and the provenance remained unknown (tab. 2).

◈ 3. Materials and methods

The materials from this study represent a batch of samples (comprising about 65 hand samples and 21 thin sections) extracted from the author's PhD research (Al. Ciornei 2013) on cherts in geological (Ghizdaru-Haltă Quarry, Giurgiu-South Western Quarry) and archaeological (Giurgiu-Malu Roşu, Nicolae Bălcescu-La Vii) contexts from the Lower Danube Valley, materials already published as a whole (Al. Ciornei *et alii* 2014).

The investigation of these cherts was done through macroscopic examination of hand specimens, optical microscopy, and bulk X-ray diffraction of uncovered thin sections. The basic macroscopic description was done with the naked eye; fresh breaks and chips were obtained with a small hammer; hand specimens were measured and weighed with standard measuring instruments. Macroscopic photographs were taken with a Nikon digital camera D40 (AF-S Nikkor 18-55 mm, 1: 3.5-5.6 GII ED). The microscopic analysis was conducted on an Olympus BH-2 petrographic microscope, using only 4× (A4 PO, 0.10, 160/-) and 10× (A10 PO, 0.25, 160/0.17) magnifications. Microscope photographs were taken with a Nikon COOLPIX 995 photomicrograph camera (Wide Field 10× and digital zoom of 3×). X-ray diffraction was conducted on a PANanalytical X'Pert θ/θ, CuK$_\alpha$ radiation, scan interval 2-55° 2θ, 10-56° 2θ, 15-70° 2θ, step size 0,0170°, scan step time 10 s.

The macroscopic examination of hand specimens had a two-fold aim: the external appearance (colour and consistency of cortex, naked eye visible fossils) and the internal look (fracture, light transmittance in thin flakes, lustre in fresh breaks, colour and play of colours, absence/presence and distribution of carbonate reminiscences, naked eye visible fossils). This examination allowed the separation of macroscopic varieties. The macroscopic variability was covered by thin sections prepared from the representative hand specimens.

Chert characterization in thin sections relied on the microfacies criteria for carbonate rocks (J.L. Wilson 1975; E. Flügel 2010): grain categories, amount, size, sorting, roundness, and mineralogy of grains; recognition of systematic fossil groups and petrographic fossil distribution (types, size, amount, and mineralogy of fossils); amount, texture, and mineralogy of the matrix; type, amount, texture, and mineralogy of cements. Amount of grains, matrix, and cement for each thin section were estimated by use of visual comparison charts (P.A. Scholle, D.S. Ulmer-Scholle 2003, p. xii). For all samples analyzed, traits indicating the diagenetic fabric were described through cumulative observations regarding dissolution fabrics, compaction (grain contacts), cementation (type and mineralogy of cements), and neomorphism. Depositional fabric for each thin section was inferred from the estimated amount of particles, matrix, cement, and also grain-support type and packing. The recorded mineralogy of each grain type, cement, and matrix represented the basis for estimated mineralogical composition in individual thin sections correlated with the X-ray diffraction patterns.

The results of the previous analysis (Al. Ciornei *et alii* 2014) were confronted with the results of microfacies analyses of carbonate rocks from Romania, a process which led to a revised interpretation of the chert microfacies (Section 4. 1.). A review of the geological information for the study area and the surroundings (regional geology), and the analysis of the geological context of the sampling locations allowed setting up the frame of the geological occurrence for the analyzed chert samples (Section 4. 2.). Also, it has been undertaken an assessment of the evidence regarding possible similar siliceous materials. This approach is based on a bibliographical review (qualitative text and image analysis of published macroscopic and microscopic descriptions, correlated with geological information) of the petro-archaeological record regarding raw materials from north-eastern Bulgaria (Section 4. 3.) and Neolithic sites in southern Romania (Section 4. 4.).

◈ 4. Results

4. 1. A revised interpretation: from peloidal to intraclastic-bioclastic cherts

Using the criteria mentioned in the previous section, seven "peloidal chert" microfacies were initially identified, representing cherts formed in shallow-marine carbonates. The thresholds used for microfacies differentiation are detailed elsewhere (Al. Ciornei 2013, p. 12-14; Al. Ciornei *et alii* 2014, p. 143-148), and they will not be reiterated here. In this revised presentation, beside those already established, one more microfacies was separated (sample NB-Vii [10], microfacies [11ab]) due to its different grains-size and slight microfauna composition in contrast to samples from microfacies [11a]. The main characteristics are summarized in captions of fig. 2-12 and tab. 3, 4.

The "peloidal cherts" have a relatively regular nodular or lenticular shape (from 5 to almost 20-30 cm long), various colours and shades (rusty brown to greyish-rosy or grey), with a rough and coarse appearance, dull, rarely greasy lustre (fig. 2, 3). Nodules retain both a coarse-granulated porous "fresh cortex" and a smooth rusty-brown or rusty-yellowish cortical surface (neocortex), traits that indicate reduced transport distances (compared with the initial limestone deposit) and long-time reworking by water (fig. 3).

These cherts are characterized by grain-supported depositional fabrics (tab. 3): packstones with fine to medium sand-sized grains (microfacies [10a], [10b], [11a], [11ab], [11b]) and grainstones with medium to coarse sand-sized grains (microfacies [12a], [12b], [12c]). They were called "peloidal cherts" (Al. Ciornei 2013, p. 13; Al. Ciornei *et alii* 2014, p. 143) because their primary constituents were identified as peloids: particles with round, ovoid, or rod-like shapes, with sizes between 70 to 850 μm, composed of microcrystalline quartz, chalcedony, megaquartz and micrite. Additional particles are non-skeletal grains (intraclasts, cortoids, ooids) and bioclast (fig. 4). In the working phase, the term peloids was used as defined by E. Flügel (2010, p. 110-111), i.e. a non-genetic term of ignorance which refers to micron- to millimetre-sized micritic grains, subrounded and rounded, but also ovoid and rod-like, without internal structures. During subsequent interpretation phases of the data, the peloids composed of microcrystalline quartz were identified as silicified mud peloids (fig. 4) and their inferred depositional setting considered as restricted inner shallow-marine (Al. Ciornei 2013; Al. Ciornei *et alii* 2014). Thus, it has been disregarded the distinction between small intraclasts and mud peloids (uniform shape, good sorting and an arbitrary size limit of 200 μm, E. Flügel 2010, p. 113) and additional characteristics of fine-grained peloidal limestones. All the peloids with microcrystalline quartz from these microfacies can be regarded as intraclasts (fig. 4). The fact that these genetically similar particles were separated as peloids and intraclasts/lithoclasts (Al. Ciornei *et alii* 2014, p. 139) has outlined a bimodal composition of this category of grains, which were derived from diverse types of penecontemporary deposits.

Fig. 2. Macroscopic views of intraclastic-bioclastic cherts from Giurgiu-Malu Roşu: **1, 3.** “Bluish-grey and dark blue coarse granulated flint”; **2, 4.** Very translucent greyish and rosy variety; **5-8.** Rusty brown (5, 6, 8) and greyish-rosy (7) varieties; samples display “fresh cortex” (red arrows), water worn cortex (blue arrows), and neocortex (white arrows), that indicate alluvial sources containing clasts with different rolling intensities and transport distances from the original host-rocks; scales are 2.5 cm; photos by Al. Ciornei (2012).
Aspecte macroscopice ale silicolitelor intraclastic-bioclastice de la Giurgiu-Malu Roşu.

Fig. 3. Macroscopic views of intraclastic-bioclastic cherts from Ghizdaru-Haltă Quarry (1-7) and Giurgiu-South Western Quarry (8): variable colours from dark greyish (1), greyish-rosy (2), to rusty brown (3-8); samples display water worn cortex (blue arrows) and neocortex (white arrows) characteristic for alluvial deposits (such as Frăteşti Formation and Danube's lower terrace); scales are 2.5 cm; photos by Al. Ciornei (2011-2013).

Aspecte macroscopice ale silicolitelor intraclastic-bioclastice de la Ghizdaru-Cariera de la Haltă (1-7) şi Giurgiu-Cariera de la SV (8).

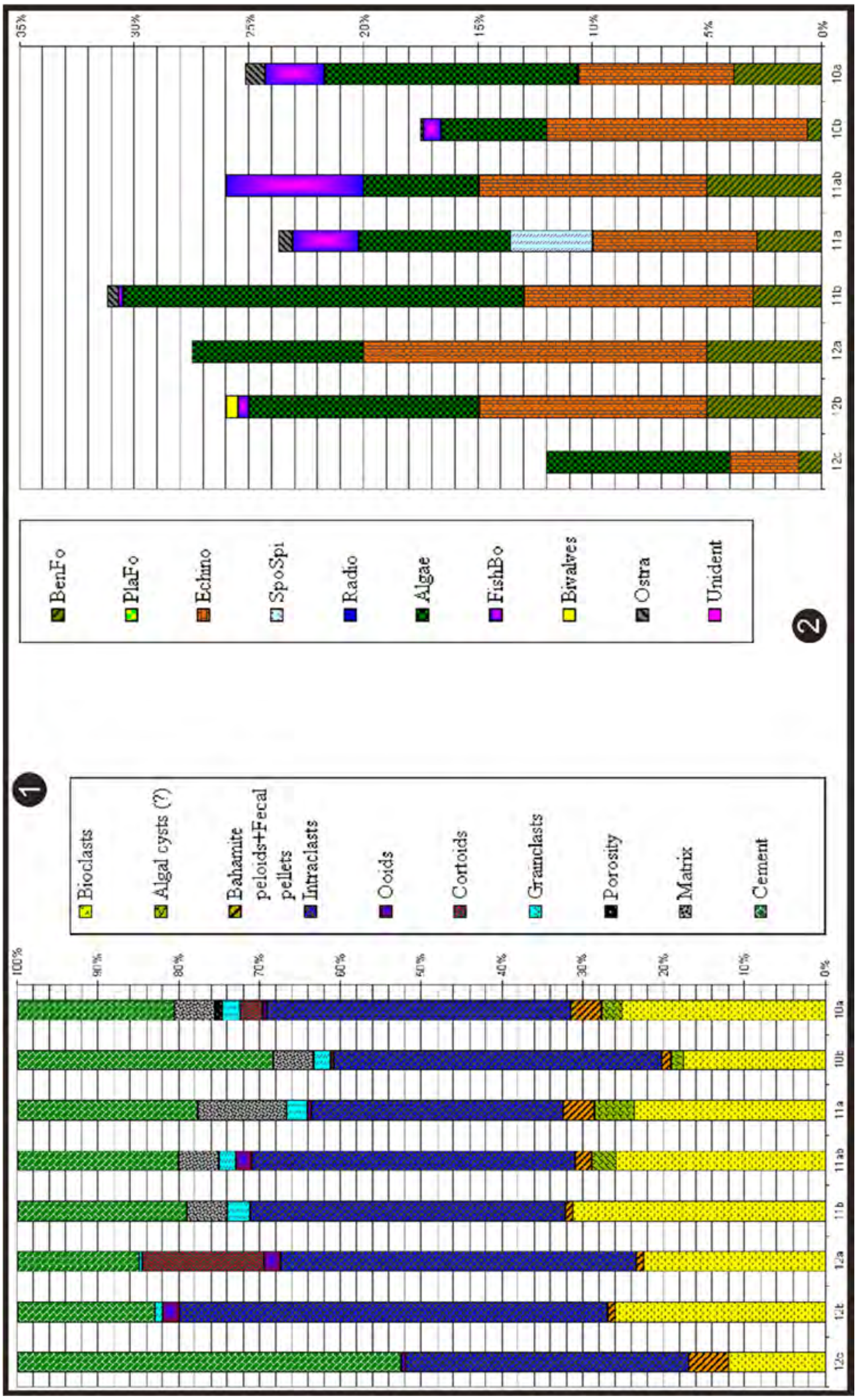
1
Bioclasts
Algal cysts (?)
Bahamite peloids+Fecal pellets
Intraclasts
Ooids
Cortoids
Granclasts
Porosity
Matrix
Cement
2
BenFo
PlaFo
Echino
SpoSpi
Radio
Algae
FishBo
Bivalves
Ostra
Unident

Fig. 4. **1.** A revised interpretation of the primary constituents of grain-supported chert microfacies from Lower Danube Valley (average values were obtained from estimated primary constituents of thin sections assigned to each microfacies): *intraclasts* - includes the particles identified as silicified mud peloids (composed of microcrystalline quartz) and the intraclasts/lithoclasts (various shapes, from ovoid to irregular, different sizes and different compositions in comparison with the peloids); *mud peloids* are micritic grains resulted from the reworking of lithified carbonate mud and micrite clasts (also called small intraclasts or lithic peloids), and are genetically intraclasts formed by erosion and redeposition within the same basin (E. Flügel 2010, p. 113); mud peloids are found in rock forming amounts in fine-grained peloidal limestones from shallow-marine, low energy, restricted inner platform environments (E. Flügel 2010, p. 117); *intraclasts* are carbonate fragments of lithified or partially lithified sediment derived from the erosion of nearby penecontemporaneous sediment from within the basin and redeposited in the same area; intraclasts are present in shallow-marine environments (supra-, inter- and subtidal settings), dominated by waves and tides, but are also found in deep water settings as transported materials (E. Flügel 2010, p. 166-167); *Bahamite peloids + Fecal pellets* - these dark coloured particles of different sizes and shapes (oval, ovate-oblong, rod-like, round) were simply identified as peloids composed of micrite, but at a closer inspection they turned up to be micritized grains and fecal pellets; *Bahamite peloids* (or micritized grains) are ooids and skeletal grains exhibiting loss of their internal structure through micritization processes, found in shallow-marine environments (E. Flügel 2010, p. 116); *fecal pellets* are fine-grained micrite grains (elongate, rod-shaped or ovoid) derived from carbonate-ingesting organisms that digest organic matter from mud and excrete lime-mud (E. Flügel 2010, p. 112-113); *cortoids* - carbonate grains (bioclasts, ooids, peloids) with a micrite envelope resulted from micritization processes, common in shallow-marine high-energy settings (E. Flügel 2010, p. 114, 118-121); *ooids* - spherical and egg-shaped grains with a nucleus surrounded by an external concentrically laminated cortex (E. Flügel 2010, p. 142-143); the low abundance of ooids suggests transportation out of the settings where they were formed (inner platform, shallow-marine high- and low-energy environments); *algal cysts (?)* - includes spherical and egg-shaped particles with sizes about 100-300 μm, initially identified as peloids composed of chalcedony and megaquartz; these particles present the characteristics of algal cysts (spherical, thin-walled and hollow) found in shallow-marine carbonates (G.F. Elliott 1986, p. 739-740; E. Flügel 2010, p. 452); their hollow part was initially filled by calcite spar, but was later dissolved and silicified, probably via a mould stage; *bioclasts* (or skeletal grains) - represented by subangular to subrounded fragments of fossils, various shapes (round, oval, irregular, rectangular);

2. Fossil types and abundance in chert microfacies from Lower Danube Valley (average values were obtained from estimated bioclast composition of thin sections assigned to each microfacies): low diversity of petrographic fossils; larger echinoderm plates and whole algae have ovoid shapes and rounded morphologies; framboidal pyrite was identified in the centre of some echinoderm plates, indicating reducing conditions and replacement of organic material triggered by bacterially controlled processes (E. Flügel 2010, p. 646-647); most frequent benthic foraminifera in these samples are miliolids (common in shallow near-shore and lagoonal environments), but also coiled, biserial and agglutinated types appear; some of the miliolids are worn and abraded or even broken (sample Giur-Ca [01]), but many of them exhibit signs of micritization, i.e a process whereby the margins of carbonate grains or the total volume of grains are replaced by crypto- or microcrystalline carbonate crystals due to microboring organisms (E. Flügel 2010, p. 118); the abrasion signs on miliolids and rounded morphologies of larger bioclasts suggests transport from the initial living environments; **Legend:** BenFo - benthic foraminifera; PlaFo - planktonic foraminifera; Echino - echinoderms; SpoSpi - sponge spicules; Radio - radiolarians; FishBo - rounded fragments of fish bones; Ostra - ostracods; Unident - unidentified.

1. O interpretare revizuită a constituenţilor primari din microfacies-urile silicolitice de pe Valea Dunării inferioare;

2. Tipuri de fosile şi abundenţa lor în microfacies-urile silicolitice de pe Valea Dunării inferioare.

No.	Particles (%)	Micrite matrix* (%)	Depositional fabric	Sorting	Grain size	Depositional setting	Marine environment
10a	74.7	5.0	packstone	moderate	fine sand	platform margin sand shoals	shallow-water
10b	63.3	5.0	packstone	moderate	fine sand	platform margin sand shoals	shallow-water
11a	66.7	11.0	packstone	moderate	fine sand	platform margin sand shoals	shallow-water
11ab	75.1	5.0	packstone	moderate	medium sand	platform margin sand shoals	shallow-water
11b	74.0	5.0	packstone	moderate	coarse sand	platform margin sand shoals	shallow-water
12a	85.0	0.0	grainstone	moderate	coarse sand	platform margin sand shoals	shallow-water
12b	83.0	0.0	grainstone	moderate	medium sand	platform margin sand shoals	shallow-water
12c	52.5	0.0	packed wackestone /grainstone	good	medium sand	platform margin sand shoals	shallow-water

Matrix – interstitial material mechanically deposited between larger grains (E. Flügel 2010, p. 73); micrite – the fine-grained matrix (1–4 μm) of carbonate rocks and the fine-grained constituent of carbonate grains (E. Flügel 2010, p. 75); packstones – grains supporting each other and a small amount of matrix; grainstones – just grains, no matrix.

* The micrite matrix has the following traits: impregnated with iron oxy-hydroxides in microfacies [10a], [11a], [11ab], suggesting a possible subaerial exposure (I.I. Bucur *et alii* 2014, p. 68); partially silicified in microfacies [11a], [11ab], [11b]; preserved as such in microfacies [10b]. The matrix in microfacies [10a], [10b], [11a], [11ab] partially surrounds the particles and alternates with areas of chalcedony cementation, suggesting deposition in the same time with the grains. The matrix in microfacies [11b] seems to be present in interparticle pores (while all sheltered voids are cemented), which implies that mud probably settled out into empty pores of underlying sediments.

Tab. 3. Depositional fabrics and environments of the intraclastic-bioclastic cherts from the Lower Danube Valley.
Fabric-uri şi medii depoziţionale ale silicolitelor intraclastic-bioclastice de pe Valea Dunării inferioare.

The diagenetic fabric of these cherts (tab. 4) suggests an early diagenetic cementation of the sediment (marine to meteoric environments) and silicification of all the constituents in meteoric environments, prior or simultaneously to lithification (M.J.F. Lawrence 1993, p. 22-23; P.L. Knauth 1994, p. 244-246, 249; E. Flügel 2010, p. 276), having various degrees of intensity: silica precipitation in intra- and intergranular voids (chalcedony and megaquartz) following carbonate dissolution, and silica replacement (microcrystalline quartz, megaquartz and chalcedony) of micrite matrix and grains simultaneous with carbonate dissolution.

The association of intraclasts, cortoids, micritized grains and ooids, rounded worn and abraded bioclasts (E. Flügel 2010, p. 116-117, 121, 142-143, 167), and absence of planktonic fossils, indicates sedimentation in a shallow-marine platform-margin environment (tab. 3), in contradiction with my previous positions (Al. Ciornei 2013, pl. 1; Al. Ciornei *et alii* 2014, p. 146-148), but in accordance with the depositional setting of some intraclastic-bioclastic grainstones and packstones from shallow-marine carbonates (tab. 5).

No.	Ground mass (%)	Cement (%)	InterPartCem (%)		Replacement (%)		SyntCem (%)		Diagenetic fabric*
10a	24.3	19.3	Qf-By	19.3	-	0.0	-	0.0	silicified packstone
10b	36.7	31.7	Qf-By	31.4	-	0.0	Cal	0.3	silicified packstone
11a	33.3	22.3	Qf-By	6.0	Qm-Gr	16.2	Cal	0.1	silicified packstone
11ab	24.9	19.9	Qf-By	10.0	Qm-Gr	9.9	-	0.0	silicified packstone
11b	26.0	21.0	Qf-By	5.0	Qm-Gr	16.0	-	0.0	silicified packstone
12a	15.0	15.0	Qf-By/+MQ	14.0	-	0.0	Cal	1.0	partially silicified grainstone
12b	17.0	17.0	Qf-By/+MQ	17.0	-	0.0	-	0.0	silicified grainstone
12c	47.5	47.5	Qf-By/+MQ	47.5	-	0.0	-	0.0	entirely silicified packed wackestone/ grainstone

Groundmass – the combined amount of matrix and cement; InterPartCem – interparticle cement; Qf-By – interparticle botryoidal chalcedony cement consisting of individual and compound fans of elongated fibres with sweeping extinction in cross-polarized light, filling the space previously occupied by a carbonate cement (R.L. Folk, C.E. Weaver 1952, p. 506, 507; R.L. Folk, J.S. Pittmann 1971, p. 1050; C. Frondel 1978, p. 24-25; M.J.F. Lawrence 1993, p. 19; P.L. Knauth 1994, p. 234-235; B. Rogala *et alii* 2010, p. 1782), sometimes associated with drusy megaquartz cement in the centre of these fillings; MQ – drusy megaquartz cement representing void-filling cement in intergranular pores and (equant to elongated, anhedral to subhedral crystals, larger than 20 μm); Qm-Gr – granular microcrystalline quartz cement (equidimensional small crystals) resulted from replacement of the matrix (R.L. Folk, C.E. Weaver 1952, p. 506; M.J.F. Lawrence 1993, p. 19); SyntCem – syntaxial calcite (Cal) overgrowth cement on echinoderm plates, some times replaced by silica, generally considered to be formed in near-surface marine, vadose-marine, meteoric-phreatic, and deep burial diagenetic environments (E. Flügel 2010, p. 295, 298).

* Dissolution of carbonate is fabric selective and ranges from: *patchy fabric-destructive* as moulds of algal cysts (?) and bioclasts filled up with Qf and MQ, indicating a dissolution stage in a meteoric-phreatic environment (E. Flügel 2010, p. 275); *incomplete dissolution fabrics* observed as carbonate inclusions in MQ replacing the calcite in bioclasts (especially echinoderm plates), and implying that silicification took place at the same time as the carbonate dissolution; *fabric-retentive* as shown by Qm and Qf replacement of bioclasts (retaining the ghost structures of algae, echinoderm plates and non-skeletal grains), also supporting a simultaneous dissolution of carbonate.

Tab. 4. Diagenetic features of the intraclastic-bioclastic cherts from the Lower Danube Valley. Caracteristicile diagenetice ale silicolitelor intraclastic-bioclastice de pe Valea Dunării inferioare.

Context	Age	Microfacies	Characteristics	Depositional setting	Reference
Pădurea Craiului Mts, Apuseni Mts (Bihor-Pădurea Craiului unit, Vârciorog Formation, Romania)	Upper Aptian-Albian	intraclastic-bioclastic grainstone and packstone	well-sorted clasts (grainstone) and poorly-sorted clasts with angular to subrounded shapes (packstones); bioclasts are echinids, bryozoans, gastropods, miliolids, orbitolinids, large agglutinated foraminifera, rudists fragments, green algae and rivulariacean-type cyanobacteria; syntaxial growth on echinid fragments	shelf slope, generated by turbiditic flows	I.I. Bucur *et alii* 2010a, p. 178
Perşani Mts (Urgonian limestones, Perşani Nappe, Romania)	Barremian-Aptian	intraclastic-bioclastic grainstone/ rudstone	high degree of sorting, subangular to subrounded, 30-40% intraclasts, 25% peloids and cortoids, 25% skeletal fragments of bivalves, gastropods, dasycladalean algae, echinoids, ostracods, and miliolids, 5% terrigenous quartz clasts, sparitic cement	open-platform margin shoals, agitated subtidal, above the fair-weather base	Al.V. Marian, I.I. Bucur 2012, p. 11, 19
Codlea area (Štramberk-type limestones, Southern Carpathians, the Getic Carbonate Platform, Romania)	Berriasian-lower Valanginian	peloidal-bioclastic, intraclastic grainstone/ rudstone	larger agglutinated foraminifera, micritization rims; cement types: early marine fibrous-acicular, non-ferroan scalenohedral calcite, drusy ferroan calcite, syntaxial calcite overgrowths on echinoderm fragments; ferruginized matrix (reddish-brown color due to variable iron oxy-hydroxide content)	shallow-marine, subaerial exposure	I.I. Bucur *et alii* 2014, p. 67-69
Piatra Craiului Massif (white limestones, Southern Carpathians, the Getic carbonate platform, Romania)	Kimmeridgian -Lower Valanginian	bioclastic-intraclastic grainstone with black pebbles	dasycladalean algae (with micritic rim around them), rivulariacean-type cyanobacteria, gastropods, coral fragments, sponges, intraclasts and black pebbles	internal platform margin, high energy subtidal environment	C. Mircescu *et alii* 2013, p. 7-8
Hulei-Mateiaş area (Mateiaş Limestone, Southern Carpathians, the Getic carbonate platform)	Oxfordian-Tithonian	bioclastic-intraclastic rudstone	corals and/or microbialite fragments (coarse fraction), intraclasts of allodapic grainstone, packstone, and calcareous breccias; the matrix is medium to fine-grained grainstone	shelf margin and the upper part of the platform slope	I.I. Bucur *et alii* 2010a, p. 10, 27-28; 2010b, p. 35, 37
60 km north of Danube, between Vedea and Ialomița (Moesian Platform, Eastern Carbonate shelf, Romania)	Late Berriasian	oolitic grainstone and wackestone	ooids, dasycladalean algae, foraminifera	shoal of the middle shelf carbonate ramp	O.N. Dragastan *et alii* 2005, p. 145-148
	Late Valanginian	oolitic grainstone	ooids, reworked mudstone intraclasts, *Favreina njegosensis* and *Favreina dinarica*, rarely dasycladalean algae		
Lovech-Veliko Tarnovo area (Urgonian limestones, Central Fore-Balkan shelf, Bulgaria)	Barremian	bioclastic-intraclastic grainstones	bioclasts (bryozoans, algae), intraclasts, oolits, and rare benthic foraminifera	slope and toe-of-slope (external-distal shelf boundary)	V. Minkovska *et alii* 2004, p. 934-936

Tab. 5. Different types of intraclastic-bioclastic limestones from shallow and deep marine environment.
Diferite tipuri de calcare intraclastic-bioclastice din medii marine de apă puţin adâncă şi adâncă.

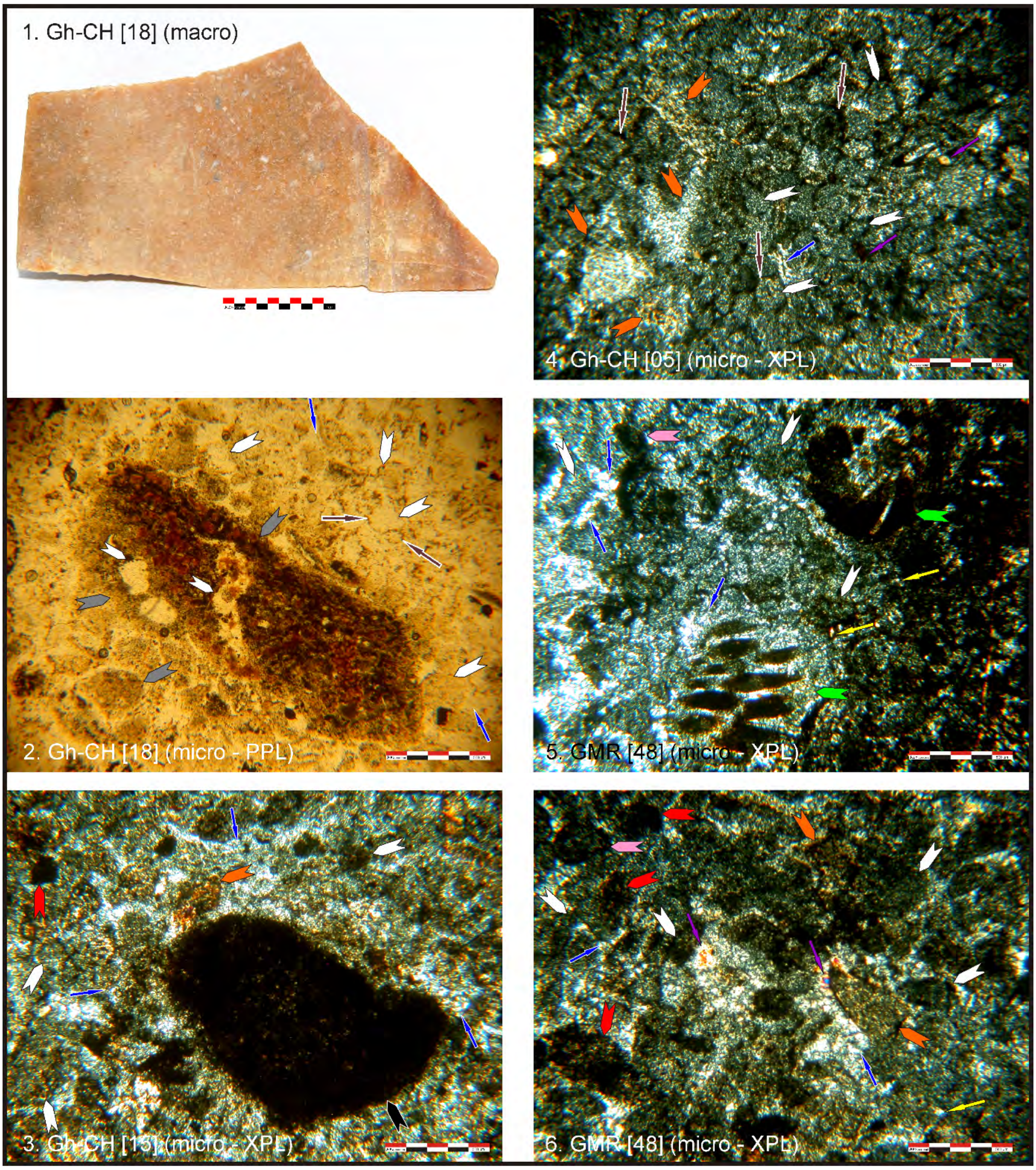

Fig. 5. Microfacies [10a]: rusty-brown colour, dull, translucent, with sporadic beige-whitish irregular and millimetre sized carbonate reminiscences; moderately sorted packstone; the space between particles is filled up by remnant micrite matrix (brown arrows), in some samples ferruginized, and botryoidal chalcedony cement (blue arrows); predominant particles are silicified intraclast (white arrows), Bahamite peloids (pink arrows), fecal pellets (red arrows), algae and echinoderm bioclasts (orange arrows), sporadic rounded fish fragments (purple arrows), quartz grainclasts (yellow arrows), Miliolid, biseriate and coiled benthic foraminifera (green arrows); other distinct and characteristic particles are large intraclasts composed either of micrite, bioclasts and quartz grainclasts (grey arrows), or micrite, quartz and clay grainclasts (black arrow); macro photo - scale is 1 cm; micro photos - scales are 500 μm; XPL - cross-polarized light; PPL - plane-polarized light; photos by Al. Ciornei (2012-2013).

Caracteristicile principale ale microfacies-ului [10a].

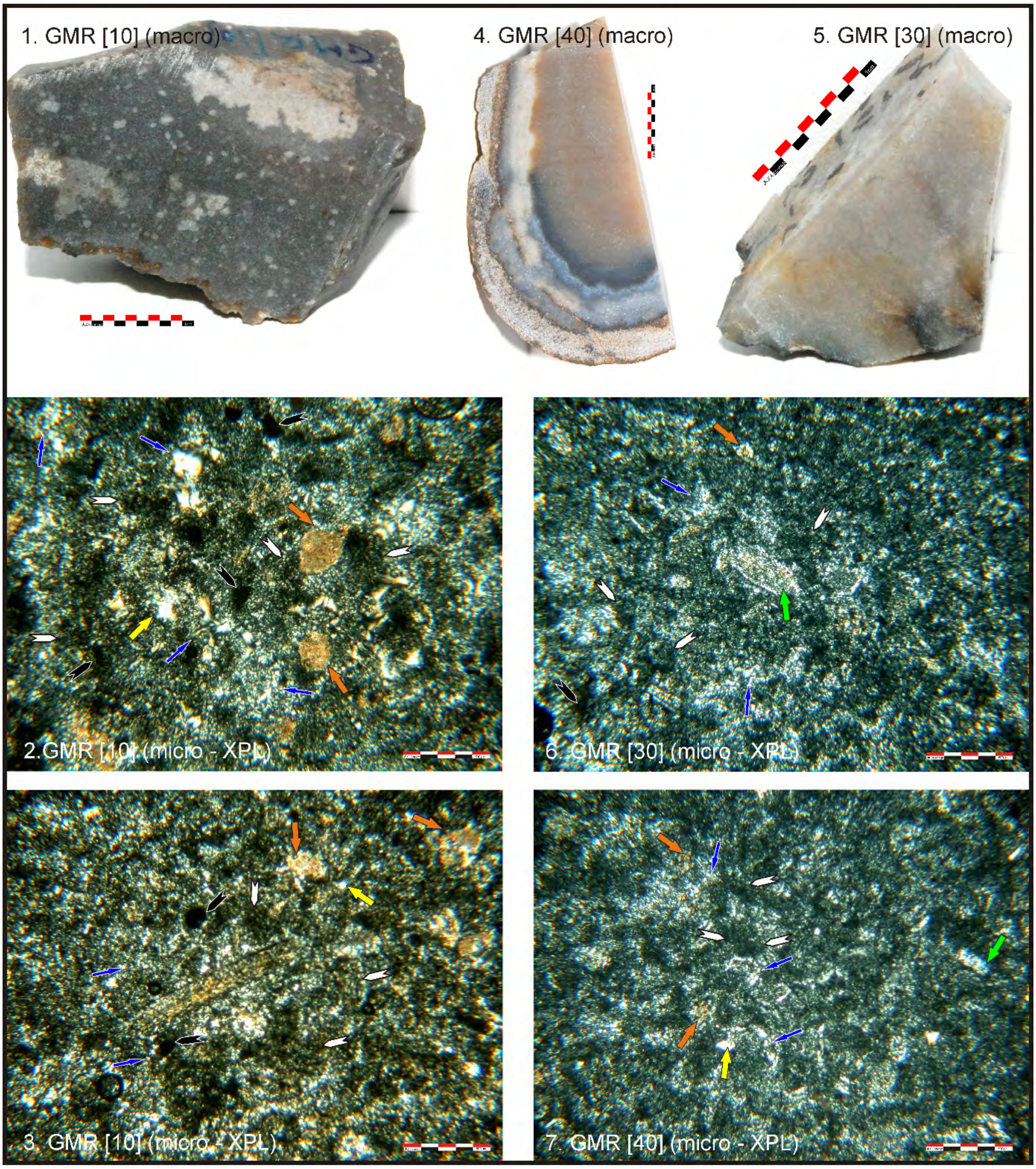

Fig. 6. Microfacies [10b]: colour from grey to rosy, dull, translucent; moderately sorted packstone; groundmass composed of remnant micrite matrix and intergranular botryoidal chalcedony cement (blue arrows); predominant particles are silicified intraclasts (white arrows); subordinate particles are fine-grained phosphatized (orange arrows) or silicified (green arrows) echinoderm bioclasts, sporadic algae fragments, quartz grainclasts (yellow arrows), fecal pellets (black arrows), and benthic foraminifera; some echinoderm plates exhibit a remnant overgrowth cement (calcite syntaxial cement) partially replaced by drusy megaquartz cement; macro photos - scale are 1 cm; micro photos - scales are 500 µm; XPL - cross-polarized light; photos by Al. Ciornei (2012-2013).
Caracteristicile principale ale microfacies-ului [10b].

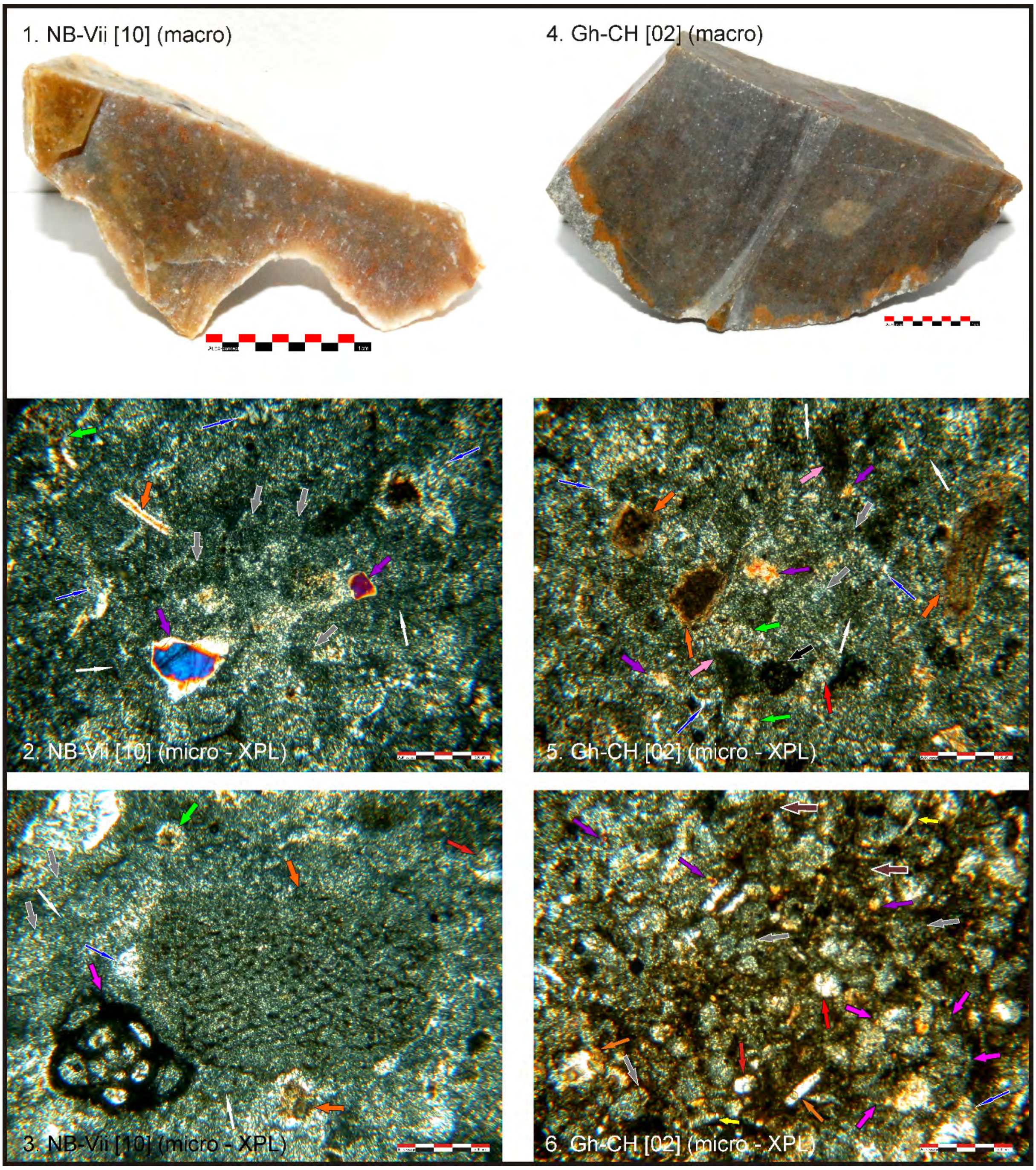

Fig. 7. 1-3. Microfacies [11ab]: clear brown, dull, translucent; moderately sorted packstone; composed of intraclasts (grey arrows), algal cysts (red arrows), fragments of echinoderms (orange arrows), algae (green arrows), and fish bones (purple arrows), miliolids (magenta arrow) and biseriate benthic foraminifera, enclosed in a micrite matrix replaced by cryptocrystalline quartz (white arrows), and a chalcedony cement (blue arrows); **4-6.** Microfacies [11a]: greyish-black, dull, translucent; moderately sorted packstone; composed of a micrite matrix, ferruginized (brown arrows) and mostly replaced by a granular quartz cement (white arrows), with pore filling chalcedony cement (blue arrows); constituent grains are intraclasts (grey arrows), fecal pellets (pink arrows), Bahamite peloids (black arrow), fragments of echinoderms (orange arrows), algae (green arrows), fish bones (purple arrows), sponge spicules (yellow arrows), miliolid, biseriate and coiled (magenta arrows) benthic foraminifera, and algal cysts (red arrows); macro photos - scales are 1 cm; micro photos - scales are 500 µm; XPL - cross-polarized light; photos by Al. Ciornei (2012).
Caracteristicile principale ale microfacies-urilor [11ab] (**1-3**) şi [11a] (**4-6**).

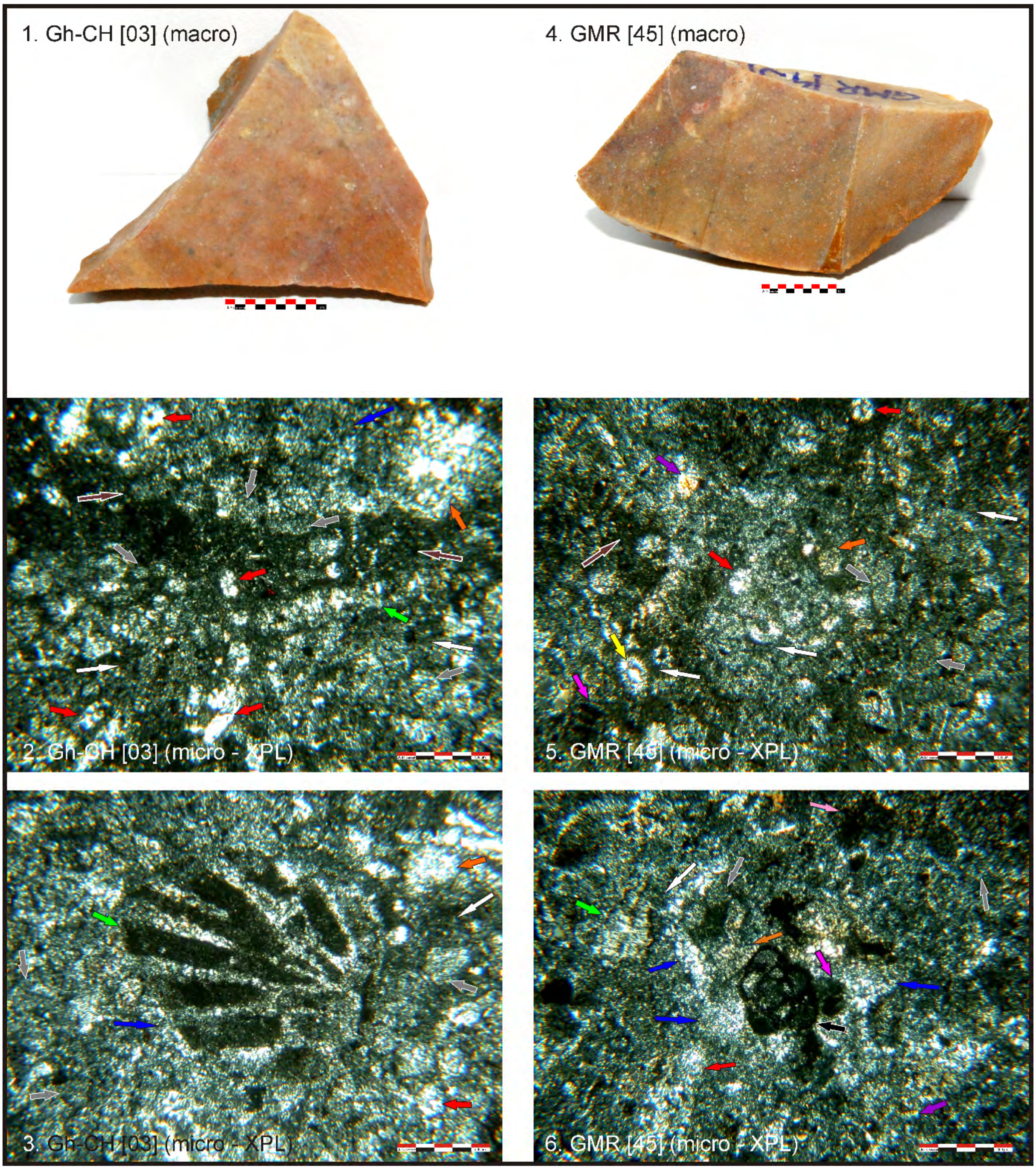

Fig. 8. Microfacies [11a]: greyish-rosy colour, dull, translucent; packstone; groundmass is composed of a micrite matrix (brown arrows), partially replaced by a granular cryptocrystalline quartz cement (white arrows), and botryoidal chalcedonic cement (blue arrows); predominant grains are oval, rod-shaped or round intraclasts, most of them silicified (grey arrows); subordinated composing particles are echinoderm (orange arrows) and algae bioclasts (green arrows), Bahamite peloids (pink arrow), fecal pellets, Miliolid (black arrow), biseriate (magenta arrows) and coiled benthic foraminifera, rounded fragments of fish bones (purple arrows), ooids (yellow arrows), and quartz grainclasts; in comparison with other samples from this microfacies and other microfacies, these samples contain the highest amount of egg-shaped and round particles (algal cysts?) filled up by chalcedony or megaquartz (red arrows); macro photos - scales are 1 cm; micro photos - scales are 500 µm; XPL - cross-polarized light; photos by Al. Ciornei (2012).

Caracteristicile principale ale microfacies-ului [11a].

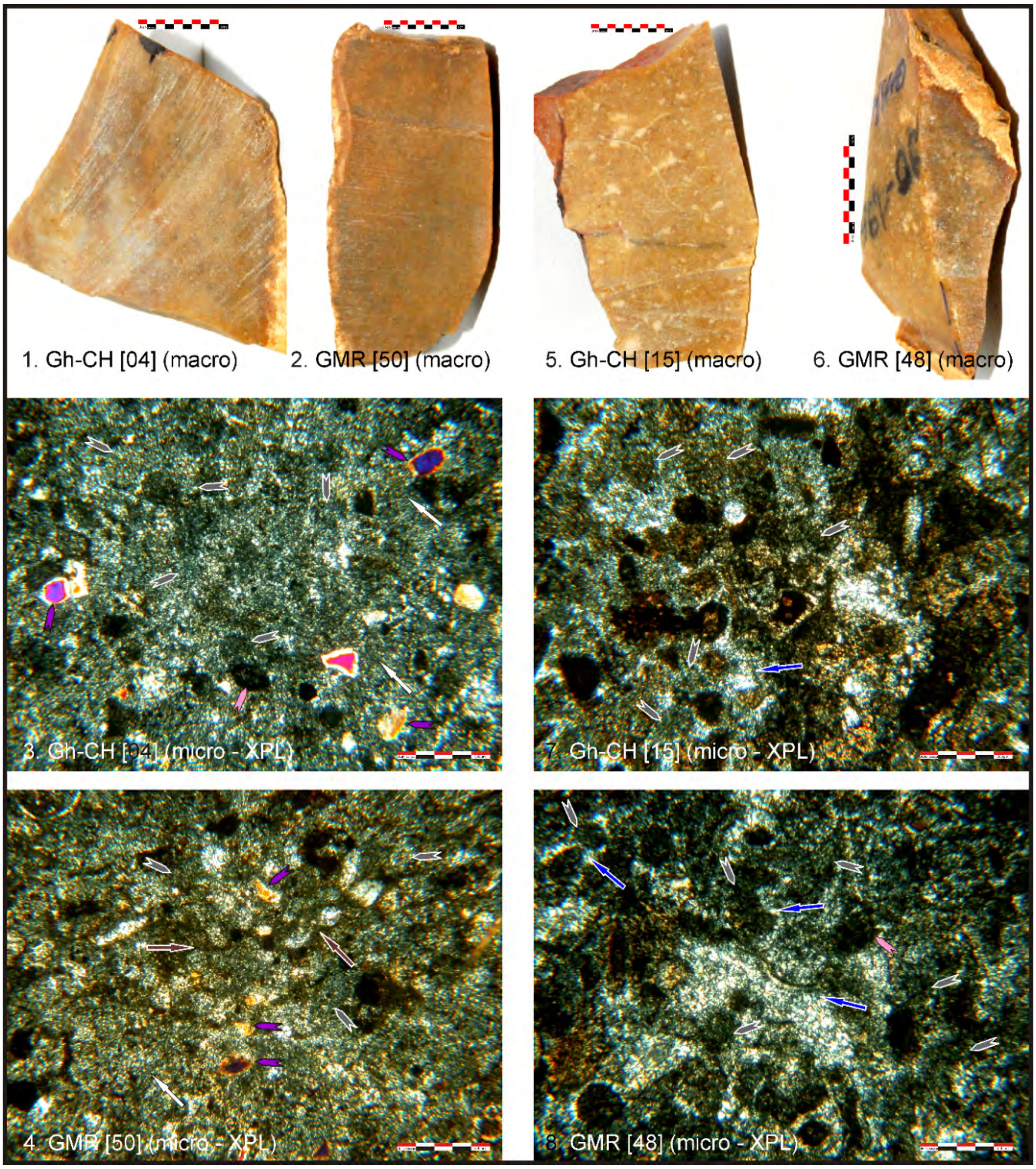

Fig. 9. Visually similar rusty-brownish cherts from Giurgiu-Malu Roşu site (2, 4, 6, 8) and Ghizdaru-Haltă Quarry sampling location (1, 3, 5, 7): **1-4.** Microfacies [11a] having as distinguishing traits abundant intraclasts (grey arrows), bioclasts, and larger fragments of fish bones (purple arrows) enclosed in a matrix, partially ferruginized (brown arrows) and partially replaced by granular cryptocrystalline quartz cement (white arrows); **5-8.** Microfacies [10a] with abundant intraclasts (grey arrows) and bioclasts enclosed in a groundmass of micrite matrix and botryoidal chalcedony cement (blue arrows); most of the blackish grains in both microfacies are fecal pellets, but some of them are Bahamite peloids (pink arrows); despite the obvious illustrated distinctive traits, these samples were very difficult to differentiate through direct comparison of thin sections before using microfacies criteria, and only after centralizing data on spread sheets they could be separated as distinct microfacies; macroscopically they are very similar and minor differences are visible in slices remained from preparation of thin sections; macro photos - scales are 1 cm; micro photos - scales are 500 μm; XPL - cross-polarized light; photos by Al. Ciornei (2012).
Silicolite similare macroscopic de la Malu Roşu (2, 4, 6, 8) şi Ghizdaru (1, 3, 5, 7).

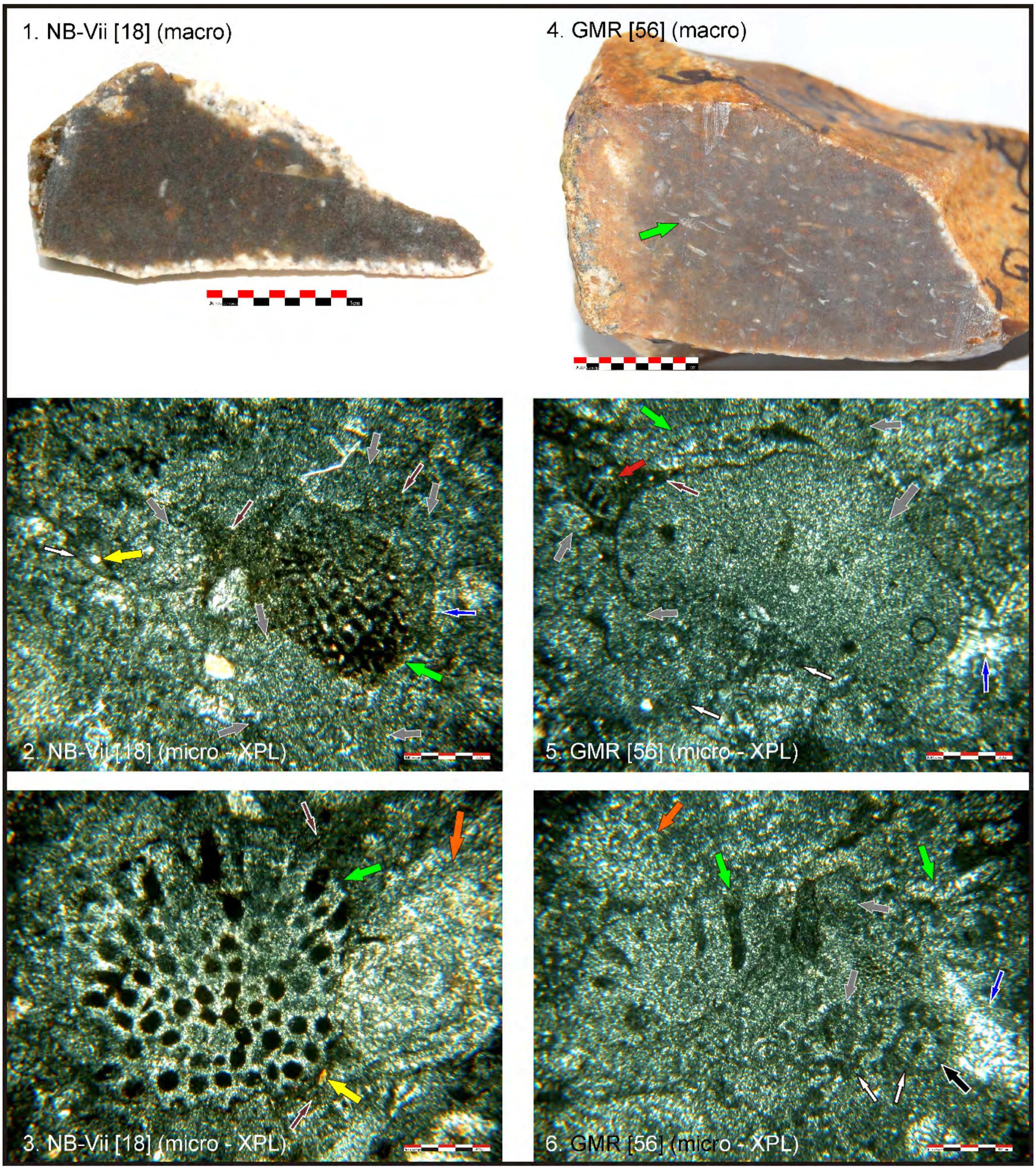

Fig. 10. Microfacies [11b]: reddish brown and greyish black, greasy lustre, very translucent; moderately sorted packstone; intergranular pores are filled up by a micrite matrix (brown arrows), partially replaced by granular cryptocrystalline quartz cement (white arrows); botryoidal chalcedony cement (blue arrow) is found only in the sheltered pore spaces; predominant particles are intraclasts (grey arrows), rounded algae fragments (green arrows), echinoderm plates (orange arrows), sand-sized quartz grainclast (yellow arrows), ooids (black arrow), and benthic foraminifera (red arrow); algae fragments are very different between these two samples and suggests either a different location inside the above mentioned depositional setting, or a different geological stage or period; also, algae fragments have similar morphologies (i.e. subrounded to rounded large bioclasts) with those from microfacies [12a]; macro photos - scale are 1 cm; micro photos - scales are 500 µm; XPL - cross-polarized light; photos by Al. Ciornei (2012-2013).
Caracteristicile principale ale microfacies-ului [11b].

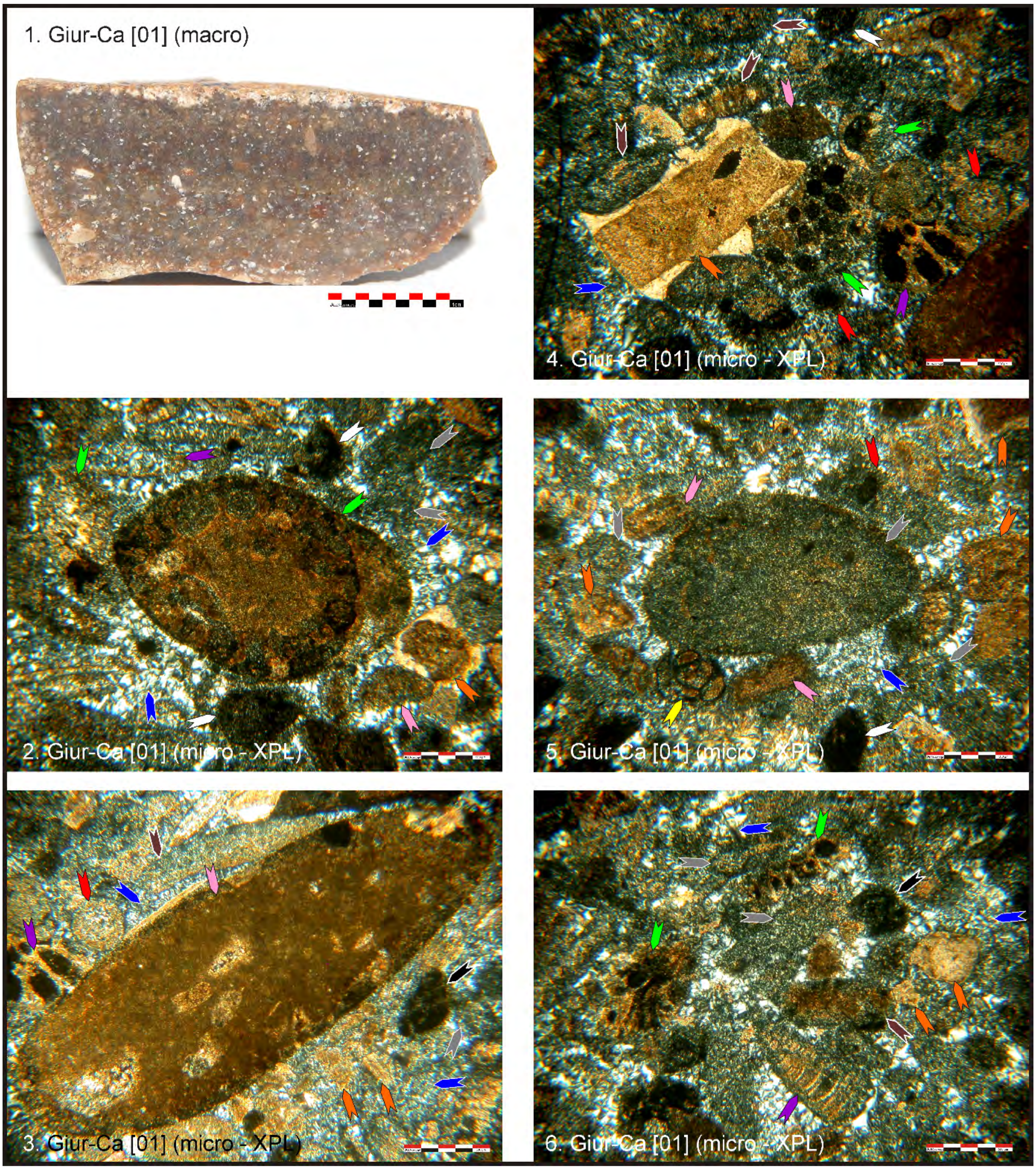

Fig. 11. Microfacies [12a]: dark brown, dull, translucent; well sorted grainstone; predominant particles are silicified (grey arrows) and phosphatized (pink arrows) intraclasts, fecal pellets (white arrows), Bahamite peloids (black arrows), cortoids (brown arrows), rounded fragments of algae (green arrows), echinoderm plates with overgrowth syntaxial cement (orange arrows), benthic biseriate (purple arrows) and Miliolid (yellow arrow) foraminifera, ooids (red arrows); the association of very rounded bioclasts, intraclasts, and abundant cortoids refer to a constant agitated shallow-water marine environment at or above wave base line (E. Flügel 2010, p. 121); pore space is filled by botryoidal chalcedony cement (blue arrows); macro photo - scale is 1 cm; micro photos - scales are 500 µm; XPL - cross-polarized light; photos by Al. Ciornei (2013).
Caracteristicile principale ale microfacies-ului [12a].

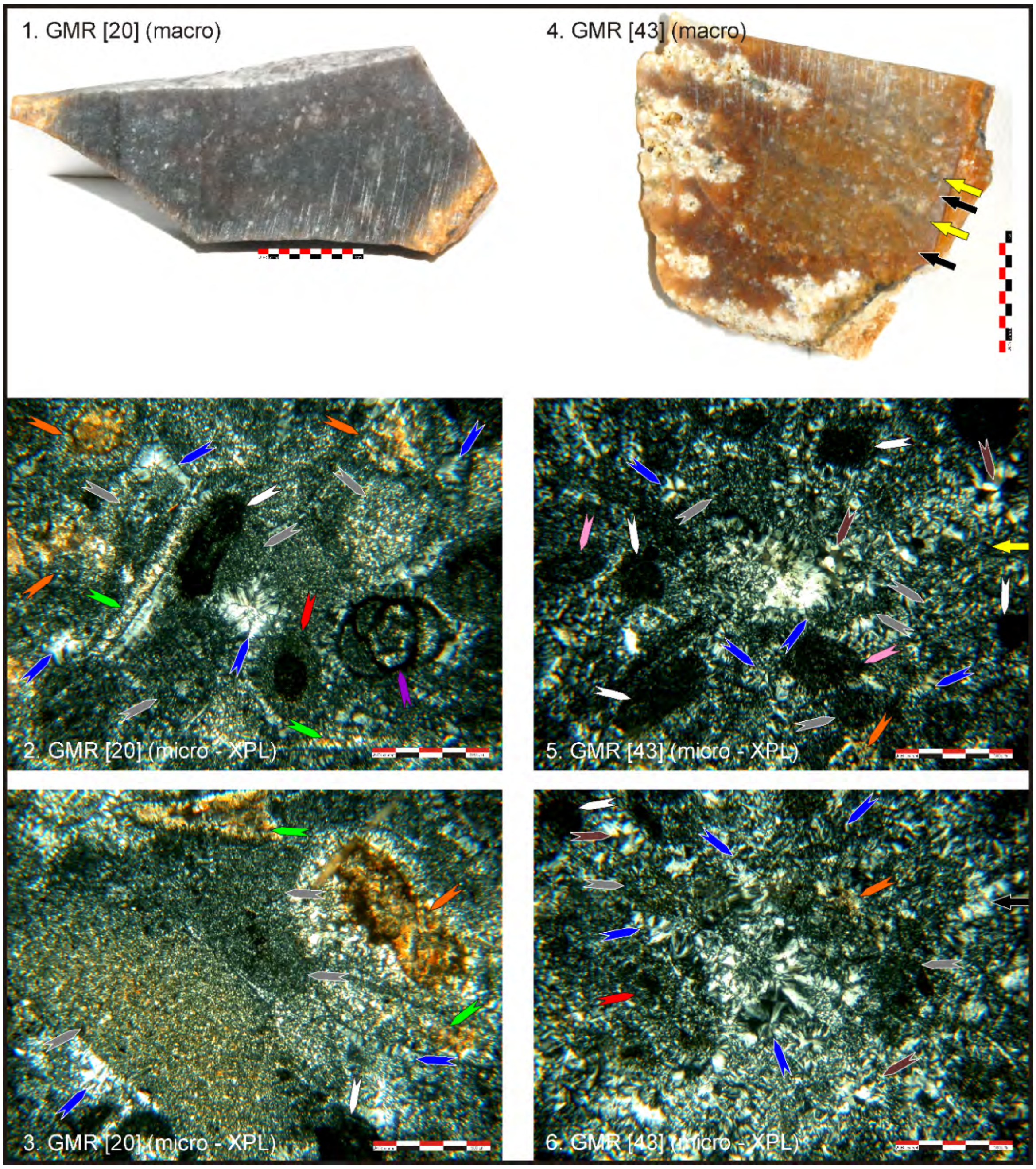

Fig. 12. 1-3. Microfacies [12b]: bluish-grey colour, greasy lustre, translucent; moderately sorted grainstone; pore space filled with botryoidal chalcedony and drusy megaquartz cement (blue arrows); predominant particles are silicified intraclasts (grey arrows), fecal pellets (white arrows), fragments of algae (green arrows) and echinoderm plates with syntaxial overgrowth cement (orange arrows), Miliolid foraminifera (purple arrow), and ooids (red arrow); **4-6.** Microfacies [12c]: rusty brownish, greasy lustre, very translucent; composed of alternating centimetre-sized brownish laminae (black arrows; grainstone fabric) and millimetre-sized clear grey laminae (yellow arrows; packed wackestone fabric); predominantly composed of silicified intraclasts (grey arrows), fecall pellets (white arrows), Bahamite peloids (pink arrows), bioclasts (orange arrows), some still recognizable ooids (red arrow); pore space is filled with botryoidal chalcedony cement (blue arrows), while the drusy megaquartz cement (brown arrows) might be related to voids infilling; the packed wackestone fabric (6) has a lower content of grains and a higher amount of cement; macro photos - scale are 1 cm; micro photos - scales are 500 μm; XPL - cross-polarized light; photos by Al. Ciornei (2012).
Caracteristicile principale ale microfacies-urilor [12b] (**1-3**) şi [12c] (**4-6**).

4. 2. Geological occurrence of intraclastic-bioclastic cherts in the study area

In the current state of research, the intraclastic-bioclastic cherts have a very restricted geographical distribution, more specifically the Giurgiu-Călăraşi area (fig. 13/1), and are found in secondary geological contexts: in the gravel deposits of Frăteşti Formation (Lower Pleistocene), together with Upper Cretaceous (K_2) nodular cherts, confirmed in locations situated north of Giurgiu city, such as Ghizdaru-Haltă Quarry and Cetatea-Bălănoaia Quarry (but this formation is also opened in other places such as the abandoned quarries from Frăteşti and Daia); in Danube’s lower terrace (t_1) deposits (Upper Pleistocene), together with K_2 nodular cherts, confirmed at Giurgiu-South Western Quarry (also opened at Giurgiu-Malu Roşu Quarry).

The Giurgiu-Călăraşi area overlays a restricted part of the structural-tectonic unit called the Walachian Sector of the Moesian Platform, extending between the Subcarpathian Nappe to the north, the Southern Carpathians to the west, the Danube to the south and the South-Dobrogean Platform to the east (P. Enciu 2007, p. 29; V. Mutihac *et alii* 2007, p. 41, 45). The crystalline basement sustains a sedimentary cover accumulated during four sedimentary cycles (D. Paraschiv 1983, p. 177; R. Muţiu 1997, p. 88-93; V. Mutihac *et alii* 2007, p. 42): Middle Cambrian-Carboniferous, Permian-Triassic, Jurassic-Cretaceous and Neogene-Quaternary (the only outcropping deposits).

The Frăteşti Fm is a lithostratigraphic unit composed of 3 to 4 cross-stratified fining-upward sequences (gravels and silty-clays, gravels and silty-sands, gravels and sands), deposited as stacked proximal to distal alluvial fans in the Walachian sector of the Moesian Platform (I. Andreescu *et alii* 2011, p. 203-205; 2013, p. 21-22). In the study area (fig. 13/1), Frăteşti Fm outcrops on the southern (1-3 m thick) and northern sides of the Burnas Plain (10-15 m thick), but also in all deeper valleys fragmenting this plain, while further east of Mostiştea valley, it is buried under the clayey-silty sequences of Coconi Fm (Middle Pleistocene) (T. Bandrabur 1966, p. 17-18; T. Bandrabur *et alii* 1966, p. 15; T. Bandrabur, D. Patrulius 1967, p. 17; P.V. Coteţ 1976, p. 54-56). North of Bucharest, Frăteşti Fm passes laterally to the fine siliciclastic sediments (clays, silts, sands) of Copăceni Beds (Lower Pleistocene) (I. Andreescu *et alii* 2011, p. 207; 2013, p. 24). Despite the debates on the age and the way these stacked alluvial fans were formed, the presence of “Prebalkan/Balkan elements” / “Prebalkan Platform elements” was admitted within the Frăteşti Fm gravels since the works of G. Murgoci and I. Popescu-Voiteşti in the first half of the XX-th century (P.V. Coteţ 1976, p. 70; M. Feru *et alii* 1979, p. 154). This clastic material indicates a Balkan-Moesian source area and deposition by rivers flowing from northern Bulgaria (P.V. Coteţ 1976, p. 32; N. Macarovici 1968, p. 216; P. Enciu 2007, p. 150; I. Andreescu *et alii* 2011, p. 215). At Ghizdaru-Haltă Quarry, the exposed cross-section of this formation shows tabular cross-bedded gravel layers (0.60 m thick) fining upward into planar bedded sand layers with thin gravel interbeds (Al. Ciornei 2013, pl. 34, 35). The orientation of the cross-stratification suggests a possible SW-NE direction of the paleocurrent (but measurements for current directions were not taken during the field surveys), in accordance with the transport directions for alluvial sediments of Frăteşti Fm (fig. 13/1; I. Andreescu *et alii* 2013, fig. 1).

Danube’s lower terrace (t_1) expands from Zimnicea to Vedea confluence, reappearing as a narrow strip from Pietroşani and continuing to widen from E-NE of Găujani up to Giurgiu, disappearing east of the city. East of Argeş, this terrace reappears from Spanţov to Mostiştea, and from Dorobanţu to East of Călăraşi (T. Bandrabur 1966, p. 10, 20-21; T. Bandrabur *et alii* 1966, 8-9, 17; T. Bandrabur, D. Patrulius 1967, p. 8, 19).

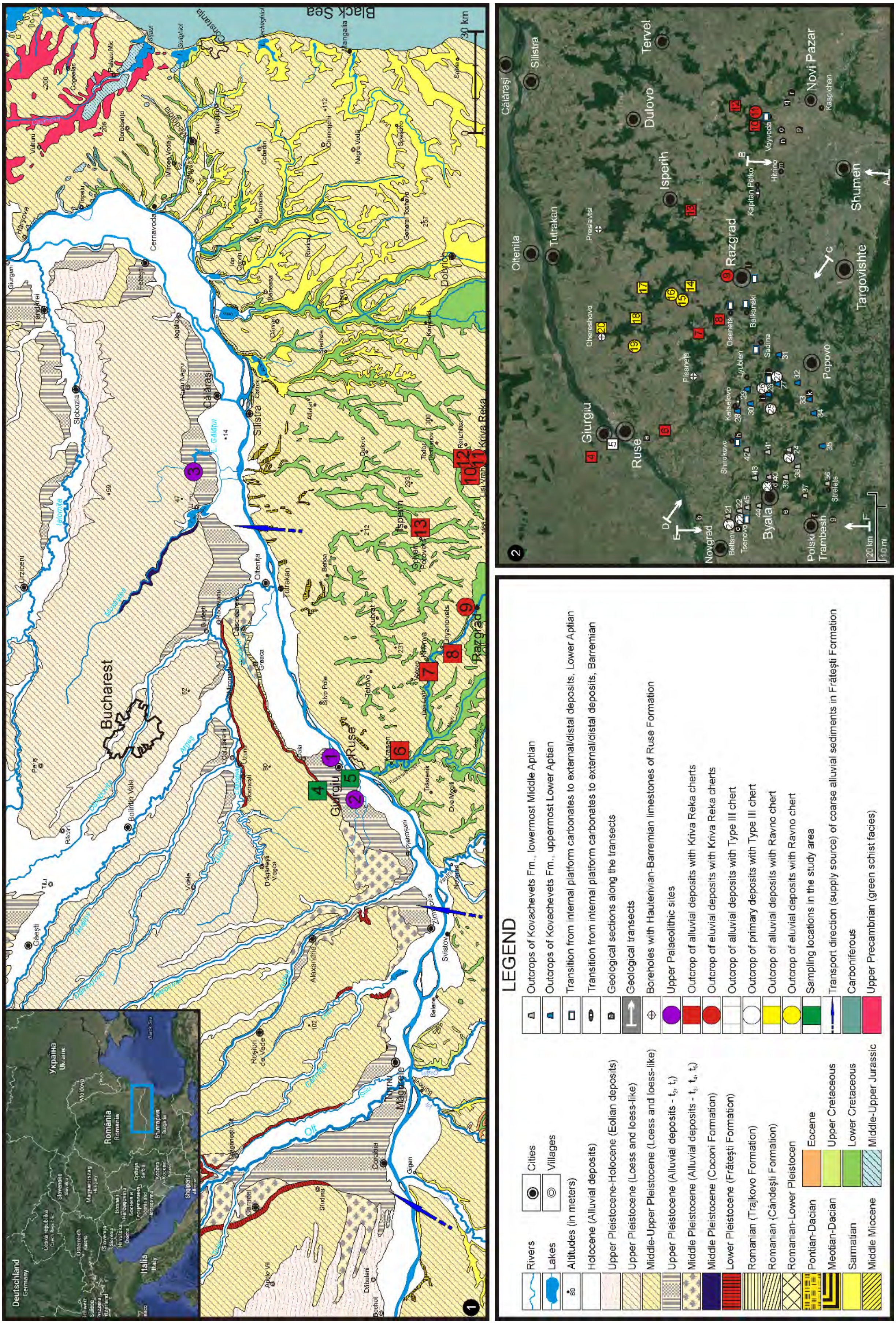
LEGEND
Rivers
Lakes
Altitudes (in meters)
Cities
Villages
Holocene (Alluvial deposits)
Upper Pleistocene-Holocene (Eolian deposits)
Upper Pleistocene (Loess and loess-like)
Middle-Upper Pleistocene (Loess and loess-like)
Upper Pleistocene (Alluvial deposits - t₂, t₁)
Middle Pleistocene (Alluvial deposits - t₅, t₄, t₃)
Middle Pleistocene (Coconi Formation)
Lower Pleistocene (Frătești Formation)
Romanian (Trajkovo Formation)
Romanian (Cândești Formation)
Romanian-Lower Pleistocen
Pontian-Dacian
Meotian-Dacian
Sarmatian
Middle Miocene
Eocene
Upper Cretaceous
Lower Cretaceous
Middle-Upper Jurassic
Outcrops of Kovachevets Fm., lowermost Middle Aptian
Outcrops of Kovachevets Fm., uppermost Lower Aptian
Transition from internal platform carbonates to external/distal deposits, Lower Aptian
Transition from internal platform carbonates to external/distal deposits, Barremian
Geological sections along the transects
Geological transects
Boreholes with Hauterivian-Barremian limestones of Ruse Formation
Upper Palaeolithic sites
Outcrop of alluvial deposits with Kriva Reka cherts
Outcrop of eluvial deposits with Kriva Reka cherts
Outcrop of alluvial deposits with Type III chert
Outcrop of primary deposits with Type III chert
Outcrop of alluvial deposits with Ravno chert
Outcrop of eluvial deposits with Ravno chert
Sampling locations in the study area
Transport direction (supply source) of coarse alluvial sediments in Frătești Formation
Carboniferous
Upper Precambrian (green schist facies)
Bucharest
Black Sea
Giurgiu
Ruse
Razgrad
Isperih
Silistra
Shumen
Popovo
Byala
Targovishte
Novi Pazar
Dulovo
Tervel
30 km
20 km
10 mi

Fig. 13. 1. Distribution of intraclastic-bioclastic cherts (Giurgiu-Călăraşi area) and Kriva Reka type of Ludogorie chert (north-eastern Bulgaria); map support was redrawn after a part of the Geological Map of Romania 1: 1000000 (M. Săndulescu *et alii* 1978), and modified with regard to Pliocene and Pleistocene formations (after I. Andreescu *et alii* 2011; 2013);
2. Geological context of Ludogorie cherts; map support from https://maps.google.ro.
Note: mapping of the Ludogorie chert outcrops locations (on both maps) has been done after I.K. Nachev, Ch. Nachev (1989, p. 84), Ch. Nachev (2007, p. 258), L. Manolakakis (2008, p. 114; 2011, p. 228-230), M. Gurova, Ch. Nachev (2008, p. 33-34), C. Bonsall *et alii* (2010, p. 11-12), B. Mateva (2011, p. 173), P. Andreeva *et alii* (2014, p. 38-42); the position of the Kovachevets Fm outcrops were mapped after T. Nikolov (1987); information regarding the transition from internal platform carbonates to external/distal deposits was mapped after T. Nikolov (1987), M. Ivanov, K. Stoykova (1998), M. Ivanov *et alii* (1997), B. Peybernes *et alii* (1998), V. Minkovska *et alii* (2002a); information on the geological transects and geological sections along the transects was mapped after M. Ivanov *et alii* (1997) and B. Peybernes *et alii* (1998); the boreholes with Hauterivian-Barremian limestones of Ruse Formation were plotted after T. Nikolov (1987); transport direction (supply source) of coarse alluvial sediments in Frăteşti Fm were drawn after I. Andreescu *et alii* (2011, 2013). Locations (on both maps): 1. Giurgiu-Malu Roşu; 2. Slobozia-Râpa Bulgarilor; 3. Nicolae Bălcescu-La Vii; 4. Ghizdaru-Haltă Quarry; 5. Giurgiu-South Western Quarry; 6. Krasen; 7. Krivnya and Senovo; 8. Ginista and Dryanovets (Razgrad district); 9. Chukata (north of Razgrad); 10. Lisi Vrah; 11. Kriva Reka; 12. Ruzhitsa; 13. Golyam Porovets; 14. Topchii; 15. Ravno; 16. Kamenovo; 17. Kubrat; 18. Belovets; 19. Tetovo; 20. Chereshovo; 21. Beltsov; 22. Tsenovo; 23. Byala; 24. Koprivets; 25. Golyamo Gradishte; 26. Krepcha; 27. Opaka; 28. Katselovo; 29. Garchinovo; 30. Gorsko Ablanovo; 31. Zaraevo; 32. Palmaratsa; 33. Kovachevets; 34. Voditsa; 35. Kamen; 36. Strelets; 37. Orlovets; 38. Dryanovets; 39. Bistrentsi; 40. Pet Kladentsi; 41. Baniska; 42. Chilnov; 43. Borovo; 44. Starmen; 45. Dolna Studena; a) Basarabovo; b) Batin; c) Beltsov and Tsenovo, d) Byala; e) Polsko Kosovo; f) Polski Trambesh; g) Sashevo (Petko Karavelovo); h) Ostritsa; i) Krepcha; j) Opaka; k) Kovachevets; l) Razgrad; m) Hitrino; n) Velino; o) Praventsi (north of Varbyane); p) Zlatna Niva; q) Stoyan Mihaylovski; r) Pamukchii.
1. Distribuţia silicolitelor intraclastic bioclastice şi Kriva Reka;
2. Contextul geologic al silicolitelor Ludogorie.

The alluvial deposits of this terrace are composed of gravels and sands (4-10 m/7-12 m/5-8 m thick). At Giurgiu-Malu Roşu Quarry, the lower terrace (t_1) is composed of a cross-laminated sand deposit with interbeds of planar bedded gravels, toped up by a planar bedded clayey/silty sand deposit (Al. Ciornei 2013, pl. 38). At Giurgiu-South Western Quarry, this terrace is composed of a planar bedded gravel layer (over 0.5 m thick, but the full thickness was not observable in the quarry) and planar laminated and cross-laminated sand layers (5-7 m thick) (Al. Ciornei 2013, pl. 37). Chert clasts from this location have a consistent small size (from 3-4 to 10 cm long), subangular contours (flake-like appearance with abraded "fresh cortex" and polished surfaces) or subrounded contours (with abraded "fresh cortex" and/or neocortex), indicating that these materials were reworked from older near-by alluvial deposits.

In north-eastern Bulgaria (the Eastern part of the Danubian Hilly Plain) there are extensive outcrops of Lower Cretaceous (K_1) limestones with cherts in primary and secondary positions (Ruse Fm, Hauterivian-Lower Aptian, and Kovachevets Fm, uppermost Lower Aptian-lowermost Middle Aptian) and Quaternary alluvial deposits with chert pebbles (T. Nikolov 1987, p. 75-80; I.K. Nachev, Ch. Nachev 1989, p. 84-85; M. Ivanov *et alii* 1997, p. 971; B. Peybernes *et alii* 1998, p. 561-562; V. Minkovska *et alii* 2002a, p. 187-191; M. Ivanov, V. Idakieva 2013, p. 50-51). The K_1 cherts were described by I.K. Nachev, Ch. Nachev

(1989, p. 84), Ch. Nachev (2007, p. 258, and references therein), M. Gurova (2008, p. 121), M. Gurova, Ch. Nachev (2008, p. 33-34, and references therein), L. Manolakakis (2008, p. 114), C. Bonsall *et alii* (2010, p. 11-12), B. Mateva (2011, p. 173), L. Manolakakis (2011, p. 228-230), P. Andreeva *et alii* (2014, p. 38-42), and they go by the name of Ludogorie (Luda Gora, Ludogorian)/Dobrudzha (Dobrodjean) flint (I.K. Nachev, Ch. Nachev 1989, p. 82; M. Gurova 2008, p. 121; M. Gurova, Ch. Nachev 2008, p. 33; B. Mateva 2011, p. 173).

Given this secondary position of the intraclastic-bioclastic cherts and the outcropping limestons with cherts immediately to the south of the study area, the next section will be dealing with the petrographic descriptions of the Ludogorie cherts, their geological context and the possible similarities with the cherts from this study.

4. 3. Ludogorie flint: a review of the petro-archaeological evidence

The Ludogorie flint is one of the siliceous materials recognized through extensive research for prehistoric raw materials in Bulgaria (M. Gurova, Ch. Nachev 2008, p. 31-32). This Lower Cretaceous material is found as nodules in Aptian micrite limestones, north of Novi Pazar, between Ruse and Dobrich (I.K. Nachev, Ch. Nachev 1989, p. 84; Ch. Nachev 2007, p. 258; M. Gurova 2008, p. 121; M. Gurova, Ch. Nachev 2008, p. 33), while a bedded siliceous rock is mentioned in the Popovski Hills region up to Yantra river (I.K. Nachev, Ch. Nachev 1989, p. 84; M. Gurova, Ch. Nachev 2008, p. 34). Two types of Ludogorie flint were differentiated based on thin section characteristics (Tab. 6). In the research context of "Balkan Flint" characterization and provenance, a batch of samples from Neolithic sites in Bulgaria was submitted to Ch. Nachev "for raw material identification by comparative thin-section analysis with flint from known sources across the Moesian Platform" (C. Bonsall *et alii* 2010, p. 11; M. Gurova 2011, p. 98). This "comparative thin-section analysis" proved inconclusive, i.e. archaeological samples were not reliably assigned to a source, especially to outcrops from Ludogorie region (C. Bonsall *et alii* 2010, p. 12), while the use of trace-element analysis outlined the fact that the macroscopically similar samples of K_2 flint from Muselievo and of Ludogorie flint from Ravno have analogous geochemical traits (C. Bonsall *et alii* 2010, p. 13).

The research carried out by L. Manolakakis, I. Ivanov, and J. Delepine (L. Manolakakis 2008, p. 114-116; 2011, p. 228-230), focused on identifying the appropriate raw material for long blade production in the Neolithic sites from NE Bulgaria (large nodules of high-quality), pointed out that K_1 flint is found as medium to small nodules in outcrops from the Beli Lom Valley and as large Aptian and Hauterivian-Barremian blocks at Ravno (tab. 6), the later representing the material mined and used for the production of long blades (L. Manolakakis 2008, p. 116; 2011, p. 230).

Recent petrographic observations and geochemical analysis (P. Andreeva *et alii* 2014, p. 38-41) on chert samples from geological sources and Neolithic sites from north-eastern Bulgaria confirmed and enriched the previous differentiated types (tab. 6). This also allows a comparison with chert microfacies from this study and some similarities to be pointed out, in combination with available information about the geological context of this area.

The petrographic characteristics of Ravno type, abundance of silicified sponge spicules and mudstone to wackestone fabrics (low-energy environment), would point out towards sedimentation in a deep water setting (I.I. Bucur *et alii* 2010b, p. 35; E. Flügel 2010, p. 496), but muddy sediments with high percentage of spicules are also specific to shallow-water shelf carbonates (E. Flügel 2010, p. 496). The location of eluvial deposits of this chert type matches with the distribution area of Urgonian limestones facies (internal/proximal carbonate platform) of the Ruse Fm (fig. 13/2, tab. 7). Also, the observations of L. Manolakakis (2008) indicate that Ravno type of Ludogorie chert has a broader geological age (Hauterivian-Barremian) than the one suggested by previous research (tab. 6).

The siliceous materials described as "type II" by P. Andreeva *et alii* (2014, p. 38-41) have identical macroscopic appearance with chert microfacies [10a], [10b, [11a], [11ab] from the Lower Danube Valley (fig. 14), but the two petrographic descriptions do not concur regarding the predominant constituents (fig. 15/1-4 for a different interpretation regarding the composition of KRL chert). The illustration for KRL chert from P. Andreeva *et alii* (2014) indicates underestimated non-skeletal grain content and the confusion between silicified small intraclasts and "microcrystalline groundmass". The petrographic characteristics of KRL chert and those of microfacies [10a], [10b, [11a], [11ab] indicate a shallow-marine high-energy depositional setting. The distribution of eluvial deposits of KRL chert corresponds with the limit of Ruse Fm (tab. 7, fig. 13/2): a high-energy platform-margin depositional setting with oolitic/granular limestones (T. Nikolov 1987, p. 76-80; M. Ivanov 1992, p. 70-71; M. Ivanov *et alii* 1997, p. 968-971; B. Peybernes *et alii* 1998, p. 559-562).

P. Andreeva *et alii* (2014, p. 41) describes KRL chert as having an "inhomogenous petrographic composition" related to wide ranges of trace-elements values. Given the fact that KRL chert was found in secondary eluvium (Kriva Reka) and paleo-alluvium (Krasen, Krivnya) deposits, the analysis of these materials failed in more than one way: 1) to separate samples from different geographic locations (sources from Beli Lom river vs. Kriva Reka and other locations) and from different geological contexts (alluvial vs. eluvial) and isolate their characteristics accordingly; 2) to consider and describe the full geological context of KRL chert outcrops (correlating the available geological information with the results of field surveys and the petrographic traits); 3) to properly consider a petrographic diversity normal for alluvial sediments, i.e. to regard Krasen and Krivnya sources from the Beli Lom Valley (and other similar sources) as possibly containing more than one chert type (a case similar to Frăteşti Fm, where the different varieties of intraclastic-bioclastic cherts are associated with K_2 nodular cherts and other rock types); 4) to consider the macroscopic features (i.e. not just colour) as a base for establishing working varieties; 5) to consider the possible existence of more varieties inside KRL chert, as indicated by the chemical variability (very high in samples from Krivnya and Krasen, and more restricted in samples from Kriva Reka, see P. Andreeva *et alii* 2014, fig. 14). Actually there is no "inhomogenous petrographic composition" (P. Andreeva *et alii* 2014, p. 41), only a petrographic diversity overlooked and poorly described, thus poorly understood (see fig. 6, 7, 8 for variability within a defined microfacies, also fig. 9 for an example of colour match and microscopic divergence).

The silicified limestone described as "type III" of Ludogorie chert has both macroscopic and microscopic traits similar to chert microfacies [12a] from the Lower Danube Valley, although the two petrographic descriptions indicate different predominant constituents and thus are conflicting (see fig. 15/4-6 for a different interpretation regarding the primary composition of type III chert). The higher values of Ca and Mg in type III are in accordance with higher percentages of remnant syntaxial overgrowth cement and echinoderm fragments in microfacies [12a] (see fig. 10/2, 10/4, 15/4-6), which are usually composed of low to high Mg-calcite (E. Flügel 2010, p. 106, 270, 295).

Fig. 14. Siliceous materials from SE Romania (1-9) visually similar to Kriva Reka type of Ludogorie chert (10-14): **1-2.** Giurgiu-Malu Roşu (Giurgiu county, Upper Palaeolithic; photo 2 modified after Em. Alexandrescu *et alii* 2007, p. 128); **3.** Ghizdaru-Haltă Quarry (Giurgiu county, alluvial deposit, Frăteşti Fm); **4-5.** Vităneşti (Teleorman county, Eneolithic; modified after O.N. Crandell 2013, p. 142); **6-9.** Baia (Tulcea county, Eneolithic; modified after Fl. Mihail, C.E. Ștefan 2014, p. 274, 276, 277); **10.** Chakmaka outcrop (secondary deposit near Isperih; modified after M. Gurova 2012, p. 33); **11.** Dryanovets (secondary deposit, Razgrad district; modified after M. Gurova 2012, p. 33); **12.** Targovishte-Garata (Chalcolithic; modified after P. Andreeva *et alii* 2014, p. 36); **13.** Kriva Reka (contemporary production centre, Shumen district; modified after P. Andreeva *et alii* 2014, p. 34); **14.** Varna cemetery (late Chalcolithic; modified after P. Andreeva *et alii* 2014, p. 30); scales are 2.5 cm.

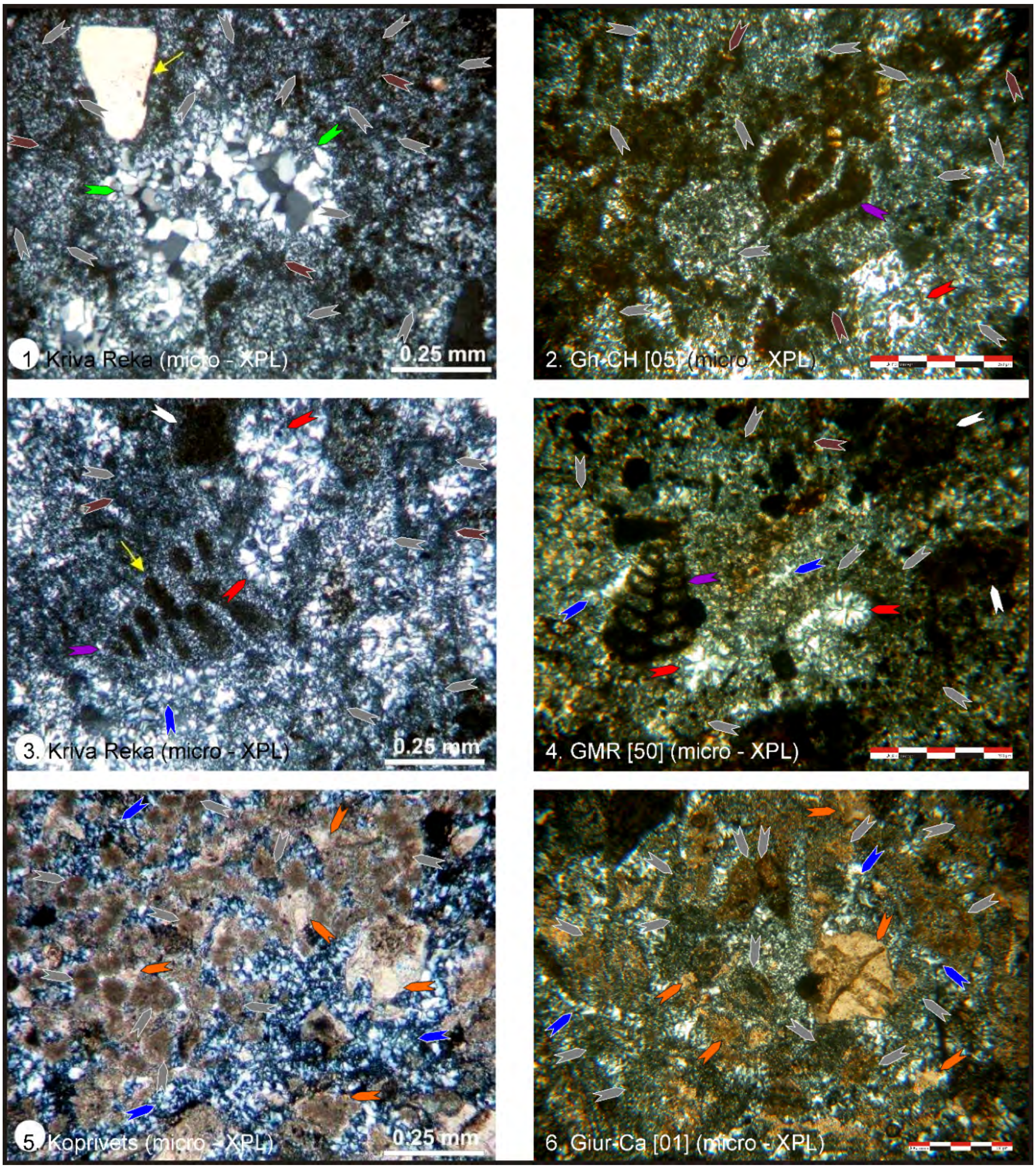

Fig. 15. 1-4. Comparison between KRL and intraclastic-bioclastic cherts: packstone fabric with silicified small intraclasts (grey arrows, underestimated in 1 and 3), fecal pellets (white arrows), benthic foraminifera (purple arrows), moulds of bioclasts (green arrows, megaquartz) and egg-shaped (red arrows); groundmass is composed of remnant matrix (brown arrows) and chalcedony cement (blue arrows); 1, 3 - samples from Kriva Reka, modified after P. Andreeva *et alii* (2014, p. 40), with yellow arrows and the scales from the original images; 2, 4 - samples from Giurgiu-Malu Roşu (4) and Ghizdaru-Haltă Quarry (2), microfacies [10a] and [11a], scales are 250 µm; **5-6.** Comparison between Ludogorie-type III and intraclastic-bioclastic cherts: grainstone fabric; small intraclasts (grey arrows, underestimated in 5), echinoderm fragments (orange arrows) with remnant syntaxial calcite overgrowth cement and botryoidal chalcedony cement (blue arrows); 5 - sample from a quarry near Koprivets, modified after P. Andreeva *et alii* (2014, p. 40), scale is from the original image; 6 - sample from Giurgiu-SW Quarry, microfacies [12a], scale is 500 µm; XPL - cross-polarized light.

1-4. Comparaţie între tipul Kriva Reka de silicolit Ludogorie (1, 3) şi silicolite intraclastic-bioclastice (2, 4); **5-6.** Comparaţie între silicolite Ludogorie-tipul III (5) şi intraclastic-bioclastice (6).

As pointed out by P. Andreeva *et alii* (2014, p. 38), type III chert is found as separate layers within the limestones of Kovachevets Fm (tab. 7, fig. 13/2), which represents a lateral, more distal, extension (southwards) of the platform-margin facies (T. Nikolov 1987, p. 76-80; M. Ivanov, K. Stoykova 1998, p. 125; M. Ivanov *et alii* 1997, p. 968-971; B. Peybernes *et alii* 1998, p. 559-562). Microfacies [11b], [12b] and [12c] (identified only in archaeological contexts, see fig. 10, 12) are more similar in composition with microfacies [12a], medium to coarse grained, macroscopic features indicating lenticular or bedded structure (see Fig. 2/5 and 2/8), possibly representing variants of type III chert with a stronger silicification degree. Considering the fact that there is a difference in silicification degree between microfacies [12a] and the sample from Koprivets (P. Andreeva *et alii* 2014, p. 40), it is possible that the bedded cherts from Kovachevets Fm have different silicification degrees related to different locations in the depositional setting (and also different stratigraphic positions).

Although the evidence and arguments presented here might not be enough for redefining and reinterpreting the KRL chert as intraclastic-bioclastic in composition, the review and comparison of the published data gives a fair idea on the shortcomings of the above mentioned studies: 1) despite the extensive research efforts and many articles published, the KRL chert was inadequately described (considering the large area where these materials were found and the large number of samples collected and analysed) and insufficiently illustrated (a few macroscopic shots and only 3 thin section photographs); 2) the physiographic distribution of the Ludogorie chert types in north-eastern Bulgaria (fig. 13/2) reflects the depositional settings (facies zones) of the Lower Cretaceous marine environments, a geological context simply ignored and unaccounted for by the Bulgarian researchers; 3) these depositional settings imply a certain degree of variability within the limestone deposits and the siliceous materials formed in them, variability in no way presumed and clearly ignored in favour of general traits and more regionally defined chert types; 4) this line of action is the reason for which these studies have failed to identify, describe and isolate more localized traits and thus properly define chert varieties and types; 5) the distribution of alluvial deposits with KRL chert along the Beli Lom Valley (Krasen, Krivnya, Senovo, Ginista, and Dryanovets) and alluvial fans with intraclastic-bioclastic cherts on the left side of Danube (Ghizdaru-Haltă Quarry), not excluding all possible deposits concealed or buried in the last 20000 years, suggests the important role played by paleo-rivers in the erosion, transport and distribution of these siliceous materials in north-eastern Bulgaria and Giurgiu-Călăraşi area, another aspect bluntly ignored by previous research of Ludogorie cherts; 6) the petrographic similarities and the general geological context suggests more than a possible connection between the materials compared here, connection totally ignored because of the one-sided character of the previous investigations.

Raw material	Characteristics	Occurrence and distribution	Reference
Ludogorie flint	from pale brown to beige (smooth fracture), rarely grey (rough fracture); abundant sponge spicules; „micro- and cryptograin chalcedony, moganite and quartz"	ellipsoidal or rod-like nodules in Aptian micrite limestones*, north-eastern Bulgaria	I.K. Nachev, Ch. Nachev 1989, p. 84; Ch. Nachev 2007, p. 258; M. Gurova, Ch. Nachev 2008, p. 33
type Ravno	"cryptocrystalline groundmass" and sponge spicules	Topchii, Kamenovo, Ravno, Koubrat, Belovets, Tetovo and Chereshovo	M. Gurova, Ch. Nachev 2008, p. 33; C. Bonsall *et alii* 2010, p. 11
type I	white cortex, homogenous or zonal texture, mostly beige-ochre-brown colours; "microcrystalline quartz groundmass" with abundant opaque minerals, chalcedonic sponge spicules, silicified sporadic foraminifer tests, thin-shelled bivalves and ostracods; replacement of spiculite mudstone and wackestone carbonates; Al, Na, K and Mg concentrations outline 3 subtypes	oval shaped nodules (sizes between 10-30 cm, but up to 70 cm long) in secondary deposits (Ravno and Tetovo), and archaeological sites	P. Andreeva *et alii* 2014, p. 38, 41
type Kriva Reka	"microcryistalline aggregates with recrystallization of chalcedony"	Goliam Porovets, Dryanovets, Krivnya, and Chukata	M. Gurova, Ch. Nachev 2008, p. 33-34; C. Bonsall *et alii* 2010, p. 11
type II	white and brown cortex; "microcrystalline quartz and chalcedony groundmass" with silicified skeletal grains, sponge spicules, silt-sized clastic quartz grains (5-15%), and "relict carbonate components" (bioclasts, rare peloids and intraclasts, 5-15%); replacement of bioclastic packstone or grainstone carbonates; wide range of Al, Na, K and Mg concentrations	pebbles and cobbles in secondary deposits (Kriva Reka, Krivnya, and Krasen), and archaeological sites	P. Andreeva *et alii* 2014, p. 38, 41
bedded siliceous rocks	"bedded calcareous chert" in vertical alternation with Aptian limestones	the Opaka deposit (Beltsov, Tsenovo, Byala, Golyamo Gradiste, Krepcha, Opaka)	I.K. Nachev, Ch. Nachev 1989, p. 84 ; Ch. Nachev 2007, p. 258; M. Gurova, Ch. Nachev 2008, p. 34
type III	dark brown to dark grey silicified limestone; bioclastic-peloidal packstone or grainstone with chalcedonic groundmass and siliceous sponge spicules; higher concentrations of Ca and Mg compared to KRL and Ravno types.	as separate layers within Kovachevo Fm (Byala, Popovo, Koprivets); in the secondary deposits (Krasen)	P. Andreeva *et alii* 2014, p. 38, 41
Lower Cretaceous flint	medium (around 30 cm long and 20 cm thick) to small nodules, but also plaques (up to 60 cm long and 20 cm thick), of mediocre to poor quality	as thin layers or high concentration in marly limestones (Chukata, Ginista, Dryanovets, Krivnya, Senovo)	L. Manolakakis 2011, p. 228-229
	large blocks and nodules of very high quality, elongated and globular shapes, with variable sizes up to 40-80 cm long (and up to 1 m), fine- to very fine-grained, brown to beige in fresh break	in Aptian residual mottled reddish clays and Hauterivian-Barremian limestones (Ravno, Topchiyska valley)	L. Manolakakis 2008, p. 114-116; 2011, p. 229-230

* From these flint-rich Aptian limestones two types of secondary deposits were derived: eluvium-proluvium, with angular flint pieces in soft sandy-carbonated masses - Kriva Reka, Tetovo, Kamenovo, Ravno, Chukata near Razgrad (Ch. Nachev 2007, p. 258; M. Gurova, Ch. Nachev 2008, p. 33; C. Bonsall *et alii* 2010, p. 11); Quaternary alluvial/paleo-alluvial with well rounded chert pebbles in sands and gravels - Dryanovets (I.K. Nachev, Ch. Nachev 1989, p. 85; Ch. Nachev 2007, p. 258; M. Gurova, Ch. Nachev 2008, p. 33).

Tab. 6. Characteristics and distribution of Ludogorie flint (north-eastern Bulgaria).
Caracteristicile şi răspândirea silexului Ludogorie (nord-estul Bulgariei).

<table>
<tr><th>Stage</th><th>Sub-stage</th><th colspan="5">Lithostratigraphic units*</th></tr>
<tr><td rowspan="3">Albian</td><td>Upper</td><td rowspan="3">Dekov Fm
anoxic black marls with intercalations of glauconitic sandstones, glauconitic marls with phosphatic nodules (basin)</td><td colspan="4" rowspan="3">Stratigraphic gap (dry land)</td></tr>
<tr><td>Middle</td></tr>
<tr><td>Lower</td></tr>
<tr><td rowspan="3">Aptian</td><td>Upper</td><td colspan="5">Trambesh Fm
clays, marls and rare thin sandstone beds, with interbeds of thin reddish siderites (basin)</td></tr>
<tr><td>Middle</td><td colspan="2"></td><td rowspan="2">Kovachevets Fm
thin-bedded silicified limestones alternating with laminated marls (external/distal platform)</td><td colspan="2"></td></tr>
<tr><td>Lower</td><td>Ruse Fm
Urgonian limestones (internal/proximal) and oolitic/granular/bioclastic limestones (rim of the carbonate platform)</td><td>Razgrad Fm
clayey limestones and marls (external/distal platform)</td><td>blue marls</td><td>Gorna Oryahovitsa Fm
basinal marls (southern most part of the Moesian Platform)</td></tr>
<tr><td rowspan="2">Barremian</td><td>Upper</td><td rowspan="2">Urgonian limestones with rudists, corals and dasycladales (internal/proximal carbonate platform) [north-western part of Kubrat region (Chereshovo borehole), Tervel-Sever and Dulovo regions (Pisanets and Preslavtsi boreholes)]</td><td colspan="3" rowspan="2">clayey limestones and marls (external/distal platform) (Polski Trambesh, Dzuljunica, northern part of Popovo region, Buhovici, Dobrich region)
- Bashbunar Member (Razgrad area), oolitic limestones (southward extension of the platform facies)</td><td rowspan="2">blue clayey marls with sandstone intercalations (external/distal platform) (Resen, Capaevo, Vasil Drumev)</td></tr>
<tr><td>Lower</td></tr>
<tr><td rowspan="2">Hauterivian</td><td>Upper</td><td rowspan="2">limestones with some coral patch-reefs (internal/proximal carbonate platform) [north-western part of Kubrat region, Tervel-Sever and Dulovo regions]</td><td colspan="4" rowspan="2">hemipelagic ammonite bearing marls and external/distal limestones with marly intercalations;
- Hitrino limestones (Kaspichan-Hitrino-Novi Pazar region), southward extension of the platform facies</td></tr>
<tr><td>Lower</td></tr>
<tr><td rowspan="2">Valanginian</td><td>Upper</td><td colspan="5">Kaspichan Fm</td></tr>
<tr><td>Lower</td><td colspan="2">micritic limestones, dolostones, dolomitic limestones, carbonates with some coral patch-reefs (internal/ proximal carbonate platform) [central and eastern parts of N Bulgaria (in drill-holes)]</td><td colspan="3">bioclastic/oolitic carbonates (rim of the carbonate platform) [in outcrops Devnja-Chernevo-Novi Pazar-Zlatna Niva area]</td></tr>
<tr><td rowspan="2">Berriasian</td><td>Upper</td><td colspan="2" rowspan="2">dolostones, dolomitic limestones and micritic limestones, with coral constructions (lagoonal environments of the internal/ proximal carbonate platform)</td><td colspan="3" rowspan="2">bioclastic/oolitic accumulations (discontinuous rim of the carbonate platform) (in drill-holes)</td></tr>
<tr><td>Lower</td></tr>
</table>

* This table was compiled with geological information from T. Nikolov (1987, p. 76-80), M. Ivanov (1992, p. 69-71), M. Ivanov, K. Stoykova (1998, p. 125-130), M. Ivanov *et alii* (1997, p. 968-971), B. Peybernes *et alii* (1998, p. 559-562), V. Minkovska *et alii* (2002a, p. 187-194; 2002b, p. 41-45), M. Ivanov, V. Idakieva (2013, p. 50-51); Fm – Formation.

Tab. 7. Lower Cretaceous lithostratigraphy of the Eastern Moesian Platform.
Litostratigrafia Cretacicului inferior din partea estică a Platformei Moesice.

4. 4. Looking for KRL chert in Neolithic sites from southern Romania

Although the matter of raw material procurement and use in the Neolithic sites from southern and south-eastern Romania is not the subject of this article, it's important to stress out the presence of materials similar to KRL/intraclastic-bioclastic cherts in this area.

In his overviews on flint types from Neolithic sites in Romania, E. Comşa (1968, p. 26-29; 1973-1975, p. 6-9, 17) doesn't describe a type similar to KRL chert. Despite this, some later accounts of the same author are worthy of attention. Amongst the raw materials used in the Neolithic site at Radovanu (Călăraşi county, Boian-Gumelniţa transition phase), E. Comşa (1980, p. 27; 1986a, p. 44; 1990, p. 30) mentions a reddish opaque flint ("yet unnamed") and considered to be of north-eastern Bulgarian origin based on a petrographic analysis (which he does't publish in these articles). For the lithic assemblage from Măgura Cuneştilor site (Călăraşi county, Gumelniţa culture), E. Comşa (1986b, p. 55; 2001, p. 22-23) describes a greyish opaque flint, found in large numbers in other Gumelniţa sites from Giurgiu area, and a reddish opaque flint, both considered to outcrop in north-eastern Bulgaria. For the same site, L. Niţă, C.E. Ștefan (2011, p. 196) describe two main flint categories, one including fine-grained materials (silex A) and one containing siliceous materials with coarse grained texture, dull, from yellowish cream, reddish brown to light grey or black (silex B). Some of the materials illustrated, though in grey scale, exhibit macroscopic traits specific to KRL cherts (L. Niţă, C.E. Ștefan 2011, fig. 2, 3).

In a raw material study of lithic artefacts from Borduşani-Popină (Ialomiţa county, Gumelniţa culture), C. Haită and M. Tomescu (in S. Marinescu-Bîlcu *et alii* 1997, p. 134) determined two petrographically distinct types of cherts (in their words "silicolites"), one of which is composed of "very frequent and large enough chalcedony recrystallization zones" and has a macroscopically fine-grained texture. Note that the "very frequent and large enough" chalcedony areas might actually correspond to chalcedony cements similar to those observed in the intraclastic-bioclastic cherts from this study (see Section 4. 1.). A later petrographic study by the same authors (C. Haită, M. Tomescu 2006, p. 409) for the raw materials from Borduşani-Popină revealed five varieties of flint, but their description is very short, mostly colour orientated and not enough for a possible connection with KRL chert.

Amongst the raw materials used in Neolithic sites from Teleorman county, O.N. Crandell (2013, p. 129) describes a "local chert" with colours and shades from greyish, yellowish to brownish, opaque and with medium to medium-fine grain, also found in alluvial deposits along the Danube and possibly derived of limestones from the opposite side of the Danube. Some of the illustrated lithic artefacts by O.N. Crandell (2013, p. 142) from Vităneşti site (Teleorman county, Gumelniţa culture) are most certainly KRL cherts (see fig. 14/4-5), but the author doesn't describe them as such, though he is aware of the Ludogorie materials from north-eastern Bulgaria.

Together with the raw materials macroscopicaly determined for the lithic assemblage from Baia site (Tulcea county, Gumelniţa culture), Fl. Mihail, C.E. Ștefan (2014, p. 269, fig. 1, 6, 7) describe as limestone a grey/grey and brown (bicoloured) raw material, and they include a dark brownish material in the Balkan flint category (Fl. Mihail, C.E. Ștefan 2014, fig. 4, 7, 8). These materials are actually KRL cherts (fig. 14/6-9), but the reason why they are not described as such escapes my comprehension.

From my own experience, I can confirm the presence of brownish KRL cherts in Neolithic sites from Neajlov Valley (Bucşani microzone, for the archaeological context see C. Bem *et alii* 2002 and reference therein), more specifically Bucşani-La Pod and Bucşani-La Pădure sites (Gumelniţa culture). A macroscopic determination (performed in 2013, unpublished) of the raw materials used for Boian lithic artefacts from Creţuleasca-Sit 2 (A3-Bucureşti-Ploieşti Highway, km 7+900 – 8+250, right side of Pasărea Valley, Ilfov county, NE from Bucharest, see P. Damian *et alii* 2012, p. 283-284) revealed that KRL cherts are represented by brownish and grey-rosy varieties, but also the bicolour variety (similar to fig. 14/13, 14/9), illustrating the full reduction sequence (from decortication to core exhaustion).

Of course, this review doesn't prove the existence of KRL chert in Neolithic sites from southern Romania and the evidence is unequal. In the few cases where a petrographic description is available for siliceous materials from Neolithic sites, the characterization is very short and/or orientated on general criteria such as colour, texture, and mineralogy. Whatever colour photos I was able to find in the published papers and my own experience with these materials suggests there is another variety of chert beside the ones recognized by previous research. This short review of the Neolithic research bibliography outlines the fact that these materials, poorly and insufficiently illustrated in other forms than drawings (mostly grey scale and rare colour photographs), are rather overlooked and amalgamated with other types of raw materials or not mentioned at all (here I should quote the whole Neolithic bibliography dealing in some way or another with the knapped lithic findings, but this is pointless).

◈ 5. Discussion

The microfacies analysis of chert samples from Giurgiu-Malu Roşu and Nicolae Bălcescu-La Vii sites (Al. Ciornei *et alii* 2014) demonstrated the existence of two main groups (intraclastic-bioclastic and bioclastic cherts) with many varieties and permitted determining reliable connections between samples from the GMR site and nearby alluvial sources, thus confirming the previous hypotheses put forth by the archaeologists (see above, Section 2).

Due to objective reasons, the field surveys in the area of NB-Vii site were cut short (stopping at Căscioarele Lake, near Olteniţa) thus hampering the possibility of comparing samples from the site and from the local raw material supply sources. Although the amount of intraclastic-bioclastic cherts in the NB-Vii raw materials hasn't been quantitatively evaluated after the microfacies analysis, the preliminary estimation suggests a minor contribution to the lithic assemblage, while the K_2 nodular cherts make up the most part, which are petrographically similar to those at GMR site and Căscioarele Lake sampling location (similar microfacies determinations, but with different colours and macroscopic aspects, see Al. Ciornei *et alii* 2014). This raw material acquisition pattern, i.e. the use of fine-grained K_2 cherts from alluvial sources of yet unknown origin, is contrasting with the supply strategies employed at GMR (see below), suggesting and possibly supporting a different cultural tradition and time line for this site in comparison to GMR, in accordance with M. Anghelinu, L. Niţă (2014, p. 185).

Regarding the provenance of intraclastic-bioclastic cherts from Giurgiu-Malu Roşu, it has been established (Ciornei *et alii* 2014, p. 148-149) that some of them (rusty-brownish and rosy-greyish varieties, fig. 2/6-7, 3/2-7, 5, 8, 9) were collected from gravels of Frăteşti Formation (10 km to the N and NW). For the other varieties of intraclastic-bioclastic cherts from Malu Roşu (microfacies [10b], fig. 6) it can only be suspected that they were collected somewhere on the left side of the Danube. It was pointed out (Section 2) that this raw material represents more than 70% of the total chert varieties from Malu Roşu, indicating a local (under 50 km) intensely exploited supply source. This source might be an alluvial deposit chronostratigraphically equivalent to Frăteşti Formation (and similar in what regards clast's dimensions and shape), found on the Bulgarian side of the Lower Danube Valley or in the Beli Lom Valley (or other river valleys). Since this type of intraclastic-bioclastic chert was not identified in the Bulgarian outcrops where KRL chert was discovered, its source must be a different type of deposit concealed in the same area. This material was also used at Slobozia-Râpa Bulgarilor, probably transported out of Malu Roşu site (if they are considered contemporaneous, as suggested by Al. Păunescu 2000, p. 286), or collected from the same source (inferring a culturally transmitted information about a local and abundant raw material source). For some other intraclastic-bioclastic cherts from GMR (varieties similar to type III of Ludogorie chert, fig. 10, 12) the source could be an alluvial deposit similar to that opened at Krasen, situated more to the south, but probably concealed or not found yet (fig. 13).

The general raw material acquisition pattern for this site (Al. Ciornei *et alii* 2014, p. 149) refers to local available and different alluvial deposits, containing both intraclastic-bioclastic cherts and bioclastic K_2 nodular cherts: Frăteşti Formation, Danube's lower terrace deposits and north-eastern Bulgarian alluvial deposits. Thus, it can be assumed that the mobility pattern of the Palaeolithic people from Malu Roşu included expeditions for raw material provisioning to the N, NW, W and E in a territory of 10-15 km, but also to the S and SE (across the paleo-Danube) in a territory of 50 km. The use of coarse-grained cherts as the predominant raw material in this site represents both a consequence of availability and a conscious preference for its qualities (other than the ease of knapping).

This brings us back to Em. Alexandrescu, B. Soare (2009, p. 56) conclusion regarding the "greyish flint with blue shades and small whitish speckles" as being a low-quality raw material for knapping, resulting in chaotic reduction of the material, with a large quantity of by-products, low amounts of blades and atypical tool morphologies. Against this idea there are a few facts and arguments that support a different view for the GMR raw materials.

First and foremost, atypical tool morphology can't be considered an argument in itself for poor quality raw material. Beyond the initial mental design, technical gestures, and intended function, tool morphology is related to specific uses throughout its life, and consequent resharpening, up to its discard. The large amount of by-products is normal for workshop sites, while the low amount of blades suggests blank selection patterns, given the fact that the blade production is fully documented in the lithic assemblage of GMR.

More so, intraclastic-bioclastic cherts collected from the Frăteşti Formation were favoured against the fine-grained K_2 nodular cherts found in large amounts in the same source (Ciornei *et alii* 2014, p. 149), while fine-grained varieties from Danube's lower terrace deposits were used only sporadically and in small quantities. This might be linked to the fact that coarse-grained lithologies with high content of silica maintain an active cutting edge for a longer time (D.R. Braun *et alii* 2009), and thus suggesting that these intraclastic-bioclastic cherts were preferred for their durability (of course, this remains to be proven by applying the tests from D.R. Braun *et alii* 2009).

In addition, KRL cherts (similar to those from GMR, fig. 14, 15) were used "for large-scale subsistence and household activities during the Chalcolithic period" (P. Andreeva *et alii* 2014, p. 26) and long and extra-long blades (fig. 14/14), at the same time when the Ravno type (a fine-grained material not found in the UP sites from the Lower Danube Valley) was intensely exploited and traded by Neolithic communities from north-eastern Bulgaria, south-eastern and eastern Romania (and beyond). Although the KRL chert was suitable for long blade production (and for any kind of knapping as long as the right techniques and methods were employed), it seems that the Ravno type was preferred for its availability as large and very large nodules (Section 4. 3.) rather than its grain size.

In the cases presented above (Section 4.4.), the materials considered as KRL cherts (or intraclastic-bioclastic cherts) account for a minor part of the total raw materials (after "Balkan flint" and "Oltenian flint", and even "Moldavian flint"). The presence of KRL cherts in sites lacking local sources with these materials (Vităneşti, Bucşani, Creţuleasca-Sit 2, Borduşani-Popină, Baia) suggests that their procurement and use is not expedient and source constrained (i.e. their availability in near-by sources), also implying some efforts made for their acquisition.

The outlined occurrence of KRL cherts in Neolithic sites from south-eastern Romania (Section 4. 4.), as an extension of their presence in north-eastern Bulgaria (P. Andreeva *et alii* 2014, p. 43), and their earlier utilization in the Upper Palaeolithic sites from Lower Danube Valley, documents the continuous exploitation and use of a raw material type with specific physical properties, stretching on thousands of years. The motives for employing KRL cherts in different times and across a relatively large area (in some cases far from known sources of this material) are an opened problem at this moment. In the current state of research, is hard to associate this exploitation with a possible continuity of the population, nor with some sort of culturally transmitted information regarding the locations of these raw materials and their mode of consumption.

As to the question raised by P. Andreeva *et alii* (2014, p. 26), i.e. "[…] how early in prehistory the exploitation of Ludogorie chert took place", there is no doubt that on the right side of the Danube the KRL cherts were exploited by the Upper Palaeolithic people from Giurgiu-Malu Roşu, Slobozia-Râpa Bulgarilor, and Nicolae Bălcescu-La Vii, long before their use by the Boian and Gumelniţa communities.

◈ 6. Conclusions

The archaeologists working in sites from Lower Danube Valley have been constantly seeking the origin of cherts used as raw materials by Upper Palaeolithic people. The answers always seemed to indicate towards the Bulgarian side of the Moesian Platform. In spite of similar rationalizations, the connection between siliceous materials from Lower Danube Valley and those from northern Bulgaria has neither been proven directly nor pursued systematically. This was due to different importance given to raw material characterization and provenance in these countries (more extensive and organized in Bulgaria, sparse and uneven in Romania), little or no collaboration between Romanian and Bulgarian researchers, and absence or low quality illustration of published chert types. Moreover the research was carried out focusing on irrelevant or misused characterization criteria (for references see Sections 2 and 4. 3.) such as: macroscopic appearance and colour used as the most characteristic and only trait for chert types, some of them having a regional or supra-regional extent; mineralogical composition, always blaming the silica content for monotony of siliceous materials and for the apparent lack of differentiation; age determinations of the raw materials derived solely from a geological context (rarely inferred based on microfauna content of chert samples).

The attempt to prove that Kriva Reka and "type III" cherts have a predominant intraclastic-bioclastic composition (based on published macro and microscopic photos, described petrographic traits, and geological information) and to outline the similarities between such materials used in different archaeological contexts (based on available archaeological information and a few macroscopic photos) is up to a point polemic and could be deemed "speculative". The basic approach engaged here to argue for these similarities is the review and comparison of published archaeological, petrographical and geological information. Review and comparison are universal investigative tools widely used in the archaeological field (and not exclusively) to evaluate and criticize other researchers' data and to make connections between findings from different areas and contexts, findings to some extent inaccessible directly (due to different reasons). To consider this approach as inadequate or improper undermines and negates the role and effort of publishing the research results. In the current situation one can only ask to what extent is better/more adequate a "comparative thin-section analysis" (see above, Section 4.3) than a "speculative" approach such as the one presented here which makes the necessary connections in a wider framework? Of course, demonstrating a petrographic similarity is preferable to be done through a proper thin section comparison (and other investigative tools), as long as comprehensive criteria are used for basic description.

This article is also signalling a trend in current research of raw material provenancing: the underestimation of petrography as an investigative tool and the employment of geochemical analysis techniques as alternative means of characterization and sourcing. The recent provenance studies of Bulgarian siliceous rocks (Section 4. 3.) provided some conflicting results (the high chemical variability of KRL chert contrasting with its alleged similar general microscopic traits, the geochemical resemblance of two petrographically and geologically distinct materials, i.e. the Ravno type and the Moesian flint) which have thrown reasonable doubt on the efficiency of petrography (focused on the mineralogy) and geochemical analytical techniques (overestimated capacity of characterization and invested with the cape of objectivity) as provenancing tools. Is quite clear from the results of chert characterization from NE Bulgaria, that describing the broad composition, the mineralogy and chemical variability of cherts is not enough, and that all observations have to be completely explained and interpreted in correlation with the original geological and physiographic contexts (i.e. depositional settings and location in the sedimentary basin), but also to consider the secondary geologic positions and the role of the rivers in redistributing cherts in a given area. Such an approach will only produce fruitful results, confirming the original observations (made under the microscope and from analytical results), or revealing faulty or biased observations and interpretations.

The microfacies analysis of the Giurgiu-Călăraşi cherts was carried out on a limited batch of thin sections (but lesser is not necessarily equal to insufficient) from the only two Upper Palaeolithic sites in the area (Section 1) and a reduced number of sampling locations (a research deficiency which impedes a comprehensive spatial distribution of sources). Nonetheless microfacies analysis has proved to be one very efficient tool for understanding and explaining the petrographic diversity ("inhomogeneous petrographic composition") of similarly macroscopic siliceous materials or the related microscopic traits of macroscopically different materials.

I think that the "debatable" and the "speculative" character of this paper is necessary for tackling the raw material characterization of these siliceous materials present in two politically separate territories and in different archaeological contexts, but also to balance the widespread characterizations of the previous works: self-sufficient (based on a large number of samples and sampling locations, but more is not necessarily enough), inadequate (in spite of the large number of samples, the characterization is very thin), territorially restricted (and thus one-sided and ignorant of the possible connections).

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