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PRELIMINARY PETROGRAPHIC DATA ON THE EARLY CRETACEOUS BOEOTHIAN FLYSCH (EXTERNAL HELLENIDES, CENTRAL GREECE); PROVENANCE AND PALAEOGEOGRAPHIC IMPLICATIONS

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Abstract: This paper defines the petrographic features of the Boeothian Flysch, an Early Cretaceous turbidite deposit which marks the boundary between the External/Internal Hellenides in central-southern Greece (south of the Kopais plain). The results from this study represent a preliminary contribution in reconstructing the Early Cretaceous palaeogeography of a limited segment of the Alpine Tethys (i. e. the Pindos Ocean), mainly supported by provenance changes of the detrital modes of arenites and related tectonic events. The Boeothian Flysch, whose stratigraphic succession is made up by basal conglomerates grading upwards to sandstones and pelites, interlayered with Calpionellid micrite limestones, is here supposed to belong to the Early Cretaceous flysch family, cropping out along all the western and central Europe Alpine Chains for more than 7,000 km, from the Gibraltar Arc to the Balkans. These flysch commonly mark the contact between the internal and external areas and usually show a provenance linked to internal areas, mainly made up by crystalline sources and, locally, by ophiolitic complexes. Representative samples of sandstones have been analyzed for petrographic compositions in order to detect the source areas. The data obtained suggest that the provenance of the Boeothian Flysch is closely related to sediment sources belonging to internal domains and formed by a Jurassic carbonate platform and metamorphic basements, connected to the Pelagonian Terranes (Auct.), and by ophiolitic complexes. Thus, it is also possible to hypothesize that Early Cretaceous uplift and rejuvenation processes affected these internal domains with production of a detrital supply, filling the innermost sector of the Pindos Ocean, whose external margin was bounded by the Parnassos microcontinent. This uplift process can, probably, represent the beginning of the late Cretaceous tectogenesis, widely recorded in almost all the central-western Alpine Tethis.

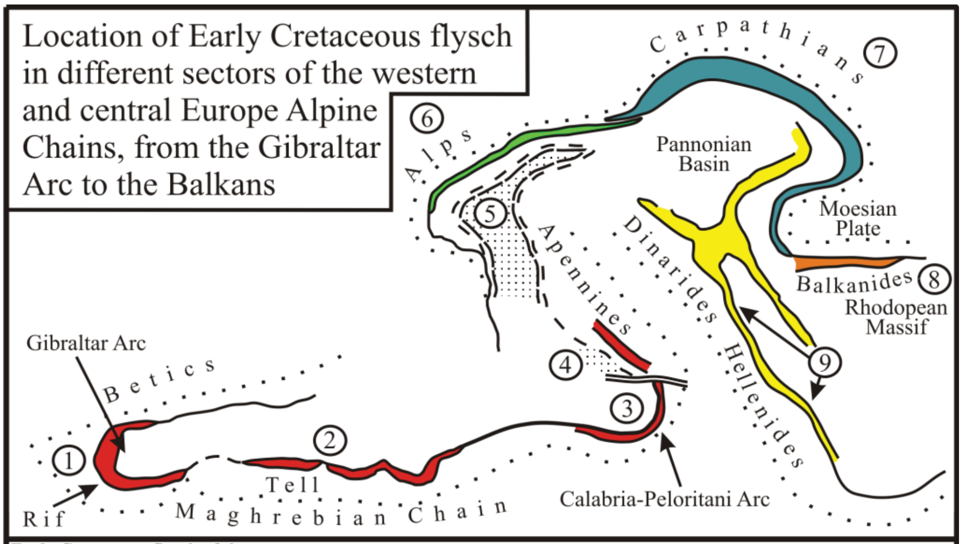
Keywords: External Hellenides, Early Cretaceous flysch, sandstone petrography, provenance, palaeogeographic reconstruction.

1. Early Cretaceous flysch in the Europe Alpine and Betic-Maghrebian Chains; palaeogeographic significance and objectives of the paper

The boundary between the internal and external areas in the western and central Europe Alpine Chains is usually marked by the presence of Early Cretaceous flysch, whose outcrops extend for more than 7,000 km from the Maghrebian Chain *s. l.* (including the Betic-Rifian Chain and the Calabria-Peloritani Arcs) to the Balkans, through Apennines, Alps, Dinarides, Hellenides and Carpathians (Fig. 1).

The deposition of these turbidite sequences (Late Jurassic-Early Paleocene) occurred in sedimentary basins floored by oceanic crust or strongly thinned continental crust and connected with the break-up of Pangaea (i. e. the Alpine Tethys).

The time span occurred between the end of the extension of these oceanic areas and the onset of their closure, usually coupled with subduction of oceanic crust and consequent formation of large ophiolitic bodies, was probably very short because a Late Cretaceous-Early Tertiary convergence-related evolution affected almost all these oceans (Schmid et al., 2008 and references therein).



Early Cretaceous flysch of the:
1-to-3- Rifian, Betic and Maghrebian Chains (Los Nogales, Jebel Tisirène, Guerrouch and Monte Soro Flysch, in Spain, Morocco, Algeria and Sicily, respectively);
4: Calabria-Lucania sector ("Liguride" pre-flysch, i. e. Frido and Crete Nere Formations);
5: Ligurian-Piedmont Ocean (South-Penninic Ocean, i. e. Palombini Shales with calcareous turbidites, Mt. Gottero Unit);
6: Valais Ocean (north-Alpine flysch of the North-Penninic Ocean, i. e. Gault, Vorarlberg and Prättigau Flysch);
7: Median (Bucovinian Nappe) and External Dacides (Black Flysch and Baraolt Flysch in the Eastern Carpathians; Severin and Sinaia Flysch in the Southern and Eastern Carpathians, respectively, representative of the Ceahlau-Severin Ocean);
8: "Nish-Troyan Flysch Trough" (north of the Moravian-Rhodopean Zone);
9: Dinarides and Hellenides, Bosnian (or Vranduk) and Boeothian Flysch, respectively.

Fig. 1. Early Cretaceous flysch along the western-central Europe Alpine Chains, from the Gibraltar Arc to the Balkans (from Puglisi 2009; modified after Durand-Delga 1980).

In fact, the different oceanic segments of the central Alpine Tethys (Ligurian-Piedmont, Vahicum and Valais Oceans and Rhenodanubian Flysch Basin; Fig. 2) as well as its easternmost sectors (Magura Basin, Pieniny Klippen Belt, Severin-Ceahlău Ocean and "Nish-Troyan flysch trough" in the Carpathians and Balkans) experienced middle-late Cretaceous tectonic events (Oszczypko, 2006; Săndulescu, 1994; Plašienka, 2003; Zagorchev, 2001; Schmid et al., 2008). The only exception is represented by the Maghrebian Chain, where these tectonic events seem to have not been recorded in its evolutionary geological history or, if recognized, they have often been neglected and/or not sufficiently emphasized (Puglisi, 2009).

The consequence of the plate tectonic re-organization during middle-late Cretaceous in the oceanic basins of the Alpine Tethys, was the strong deformation of the Early Cretaceous flysch.

In particular, this paper is aimed to check the sedimentary provenance and the palaeogeographic setting of the Boeothian Flysch (Clément, 1971; Celet et al., 1974; Celet et al., 1976), an early Cretaceous flysch of the Hellenides segment of the Alpine Chain.

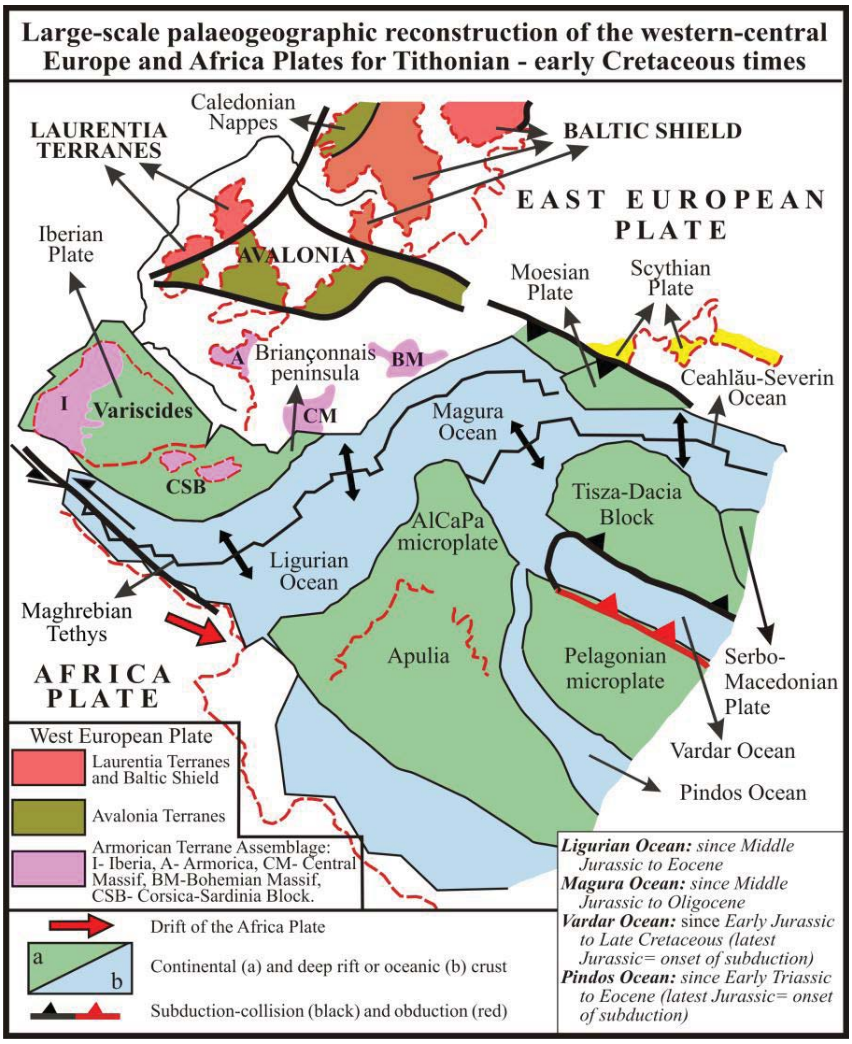
This formation was probably deposited in the inner sector of the Pindos Ocean, an Early Triassic-to-Eocene basin located between the Apulian microplate and the Pelagonian terranes (Channel and Kozur, 1997; Van Hinsbergen et al., 2005).

The present study, performed by petrographic approach, will be associated to a comparison with other coeval deposits of different sectors of the central Europe Alpine Chains, in order to verify the existence of a same tectonic framework on the base of similar compositional characters.

2. Geological setting of the Boeothian Flysch

The Boeothian Flysch crops out in the innermost sector of the External Hellenides (southern part of the Boeothia, south of the Kopais plain, Fig. 3) and it represents a thin terrigenous succession, 30 to 120 m thick, formed by a rhythmic alternance of variegated marls, shales, thin-bedded sandstones and marly limestones, with conglomerate horizons in its lower part. Limestone beds are locally rich in calpionellids, whose association is known in literature as related to an Upper Berriasian age (Newmann and Zacher, 2004, and references therein).

The innermost sector of the Pindos Ocean seems to be the sedimentary basin of the Boeothian Flysch. This basin represents one of the two branches of the central sector of the Neotethys Ocean (Pindos



Ligurian Ocean: *since Middle Jurassic to Eocene*
Magura Ocean: *since Middle Jurassic to Oligocene*
Vardar Ocean: since *Early Jurassic to Late Cretaceous (latest Jurassic= onset of subduction)*
Pindos Ocean: *since Early Triassic to Eocene (latest Jurassic= onset of subduction)*

Fig. 2. Large-scale palaeogeographic reconstruction for Late Jurassic–Early Cretaceous times (from Puglisi 2009, modified by Channell and Kozur, 1997; Csontos and Vörös, 2004; Stampfli, 2005).

Ocean to the west and Vardar-Axios Ocean to the east; Clift, 1992; Degnan and Robertson, 1998), separated by the Pelagonian microcontinent (Mountrakis, 1986; Jones and Robertsaon, 1991), which comprised major platforms (including the Parnassos platform in its western sector) during Jurassic times (Fig. 2).,

Thus, the Boeothian Flysch represents the first siliciclastic sedimentary input in the Pindos Ocean, occurred during Early Cretaceous times, when westerly directed compressions affected the Pelagonian microcontinent, leading the progressive suturing of the Hellenide orogenetic belt.

This compression, during Early Cretaceous times, emplaced remnants of the Vardar-Axios Ocean (ophiolite obduction) onto the Pelagonian microcontinent, while the subduction of the Pindos oceanic basement eastwards beneath the Pelagonian microcontinent continued until the end of Cretaceous with accretion of the main volume of Mesozoic-Upper Cretaceous sediments of the Pindos Ocean basin to the western margin of the Pelagonian microcontinent (Mountrakis, 2006).

Furthermore, the Late Cretaceous sedimentary evolution of the Pindos Ocean is marked by abundant radiolarian and organic-rich facies, followed by a Middle Cenomanian sediment-starved characterized by the presence of black shales, suddenly interrupted by new calcareous and/or siliciclastic supply during Late Cretaceous times (Newmann and Zacher, 2004)

3. Petrographic characters of the Boeothian Flysch sandstones

The Boeothian Flysch sandstones mainly contain high amounts of serpentinized ophiolitic clasts,

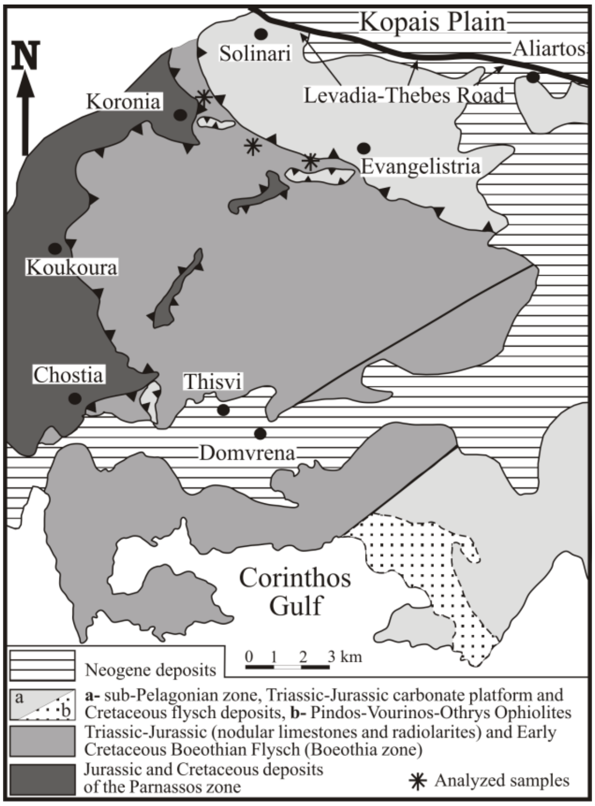


Fig. 3. Geological sketch map of the southern Boeothia (central-southern Greece), where the analyzed samples have been collected.

whose provenance is still debated because it can be dubitatively related to the Vardar-Axios or Pindos oceanic crust (Robertson, 1991), and sub-angular to sub-rounded shaped quartz grains together a conspicuous lithic fraction, mainly represented by metamorphic and carbonate rock fragments.

The samples, collected from thin-bedded well-cemented sandstones cropping out in southern Boeothia (Fig. 3), show grain size ranging between -1,5 φ and 0 φ.

The petrographic study of the Boeothian Flysch sandstones is focused on recognizing the gross composition and the textural characters of the grains in order to detect the provenance of the detrital supply.

This study has been carried out by means of modal analyses, performed by thin section point-counting according to the criteria suggested by Dickinson (1970) and Gazzi et al. (1973) in order to minimize the effect of grain-size on the estimation of the rock composition.

The results of the modal analyses of the Boeothian Flysch sandstones are listed in table 1.

The detrital framework of the analyzed rocks is characterized by a dominant extrabasinal fraction, made up by abundant lithic fragments (carbonate and ophiolite-like clasts, and minor amounts of epimetamorphic and plutonic rock fragments), by quartz and low percentages of feldspars, almost exclusively represented by plagioclase single grains.

Carbonate rock fragments show different grain size and structural characters; the finer clasts can be ascribed to micritic limestones, whereas the coarser ones can be related to different categories, such as (i) peloid limestones, (ii) calcarenites and/or calcilutites, (iii) breccia limestones with clasts of pel-microsparites, pel-bio-microsparites with benthic foraminifers and algal and sponge fragments (Fig. 4a).

In particular, the occurrence of sponge fragments such as *Cladocoropsis* cfr. *mirabilis* FELIX (Fig. 4b) could suggest a provenance from carbonate platforms.

The ophiolitic clasts, usually sub-rounded, locally show a porphyritic-like texture due to the presence of plagioclase phenocrysts (highly altered and often replaced by calcite), set in fine-grained oligo- to meso-hyaline groundmass; this latter is mainly formed by a felt of twinned plagioclase microlites, opaque minerals and rare ghosts of mafic minerals. Otherwise, it is also possible to observe groundmasses with an ophitic-like structure, where subhedral plagioclases, still recognizable, form a very intricate felt with the interstices filled by opaque minerals and probably by other mafic minerals, which are difficult to be identified because of their strong alteration (Fig. 4c).

Epimetamorphic rock fragments are also subordinately present as clasts of phillites and metapelites (Fig. 4d) and as very frequent polycrystalline detrital quartz grains with crenulated and sutured crystal-crystal boundaries, whose provenance is connected to low rank metamorphic sources.

According to the Basu's (1985) criteria, quartz grains of the analyzed sandstones can be subdivided into monocrystalline grains (of low and high undulosity, i. e. ≤5° or >5° apparent angle of extinction, measured with a flat-stage) and polycrystalline grains (with few or many subgrains, i. e. ≤4 or >4 crystal units/grain).

Polycrystalline quartz grains are usually more abundant than the monocrystalline ones and, in particular, the monocrystalline grains with high undulosity and the polycrystalline quartz grains

Table 1. Modal point counts of the Boeothian Flysch sandstones

		A3	*C1*	C2	C3	D5	D7	*F1*	F2	F4	F17
Q	Qm’	7.9	1.3	5.3	4.4	6.9	7.7	6.9	7.9	8.3	5.6
	Qm’’	10.9	6.1	5.8	6.3	12.5	13.0	10.7	12.7	10.9	11.9
	Qp’	8.4	2.4	4.1	5.3	11.2	10.9	7.2	9.6	10.5	8.2
	Qp’’	12.7	9.2	8.9	7.1	16.3	15.9	13.7	15.7	13.7	14.7
	Ch	2.4	0.6	0.9	1.3	2.1	1.5	1.1	2.2	1.7	1.4
F	Ps	5.3	2,5	3.5	4.9	6.3	5.9	5.7	4.3	3.9	5.5
	Ks	-	-	-	-	-	-	0.4	0.7	-	0.9
L	Cmic	3.6	8.3	7.5	9.1	3.1	2.7	3.5	4.0	3.9	5.8
	Ccalc	1.9	12.5	11.9	12.3	7.8	8.4	3.1	2.1	2.5	4.1
	Co/p	4.8	19.7	16.6	13.8	6.7	3.9	-	2.4	-	-
	Fo	-	-	0.3	1.4	-	-	0.4	-	-	-
	Oph	13.7	15.8	13.8	10.3	5.7	7.2	16.9	14.7	13.7	8.5
	Ls	5.8	3.1	4.3	6.1	3.3	6.9	2.3	1.7	4.3	0.9
	Lm	10.1	11.9	9.6	8.7	10.5	11.3	17.1	12.6	17.4	19.7
	Ms	2.3	-	-	1.7	3.4	1.1	1.2	1.1	1.9	3.5
	Op	2.1	2.4	1.9	2.9	-	-	0.8	1.9	2.5	1.7
	Mt	6.2	4.2	5.6	4.4	4.2	3.6	6.9	4.9	0.9	1.3
	Cm	1.9	-	-	-	-	-	2.1	1.5	3.9	6.3
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Q	48.4	21.0	13.4	26.8	53.0	51.4	44.5	53.1	49.7	47.9
	F	6.0	2.7	1.9	5.4	6.8	6.2	6.9	5.5	4.3	7.3
	L	45.6	76.3	84.7	67.8	40.2	42.4	48.6	41.4	46.0	59.4
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Qm	21.5	7.9	12.0	11.8	21.0	21.7	19.8	22.7	21.1	20.1
	F	6.0	2.7	1.9	5.4	6.8	6.2	6.9	5.5	4.3	7.3
	Lt	72.5	89.4	86.1	82.8	72.2	72.1	73.3	71.8	74.6	72.6
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Lc*+ Ls	40.4	61.4	63.9	69.9	56.3	54.2	23.4	31.3	25.6	27.7
	Lm	25.3	16.6	14.8	13.8	28.3	28.0	38.5	31.7	41.6	50.5
	Oph	34.3	22.0	21.3	16.3	15.4	17.8	38.1	37.0	32.8	21.8
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Symbols of the parameters adopted for the modal analysis

Q= Q_m + Q_p, where: Q= total quartzose grains including Qm= monocrystalline quartzose grains subdivided into Qm’= low undulosity (< 5°) and Qm’’= high undulosity (> 5°), Qp= polycrystalline quartzose grains (including Ch= chert), subdivided into Qp’= with few subgrains (≤ 4 crystalline units per grain) and Qp’’= with many subgrains (> 4 crystalline units per grain);

F= total feldspar grains, nearly exclusively represented by single grains of plagioclase (Ps);

L= Lc + Lm + Ls+Loph, where: L= unstable fine-grained rock fragments (< 0.06 mm, including: Ls= terrigenous sedimentary, Lc= carbonate, Lm= epimetamorphic lithic fragments and Fo= fossils), Loph= ophiolitic-like clasts;

Lt= L + Qp, where: Lt= total lithic fragments (both unstable and quartzose);

Ms= micas and/or chlorites in single grains; Op= opaque minerals, Mt= siliciclastic matrix; Cm= carbonate cement;

Lc*= carbonate rock fragments (also including the chert clasts, Ch) subdivided into: Cmic = micritic limestones, Ccalc = calcarenites and/or calcilutites, Co/p = oolithic and/or peloid limestones, Fo = fossils.

with many subgrains (Qm’’ and Qp’’ in table 1, respectively) are the most representative varieties.

A further important petrographic character of the analyzed rocks is the extreme scarcity of feldspars in spite of the abundance of lithic fragments and, subordinately, of quartz.

Feldspars, in particular, are almost exclusively represented by single grains of plagioclase crystals whose content never exceeds the 7 %; K-feldspar is nearly always absent and its presence is only recorded in traces, within some very rare coarse-grained plutonic-like rock fragment.

Furthermore, it is important to remember that the above-mentioned Qm’’ and Qp’’ are the weakest varieties among of the detrital quartz grains and they point to be selectively destroyed by mechani-

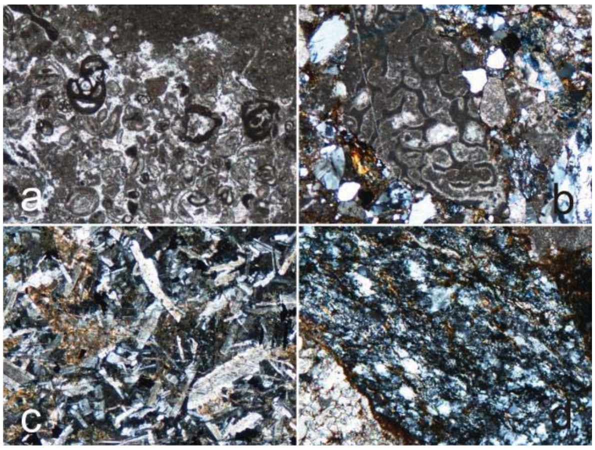


Fig. 4. Thin section microphotographs (25 x) of coarse-grained arenaceous turbidites from the Boeothian Flysch (Internal Hellenide Chain). **a**: clasts of shallow-water detrital limestones with benthonic foraminiferal (Miliolidae and Textulariidae families) and sponge fragments (*Cladocoropsis* cfr. *mirabilis* FELIX, **b**); **c**: diabase-like clasts with typical ophitic texture; **d**: epimetamorphic rock fragments.

cal processes during prolonged transport and/or during successive sedimentary cycles.

The abundance of these peculiar varieties of detrital quartz (i. e. Qm’’ and Qp’’), typical components of epimetamorphic rocks, together with the scarcity of feldspar grains, should be indicative of the presence of low-grade metamorphic rocks in the sediment sources. In any case, these data point to the exclusion of conspicuous contributions from plutonic and/or high grade metamorphic source. However, in the western Pelagonian zone there are several large granitic bodies of Late Carboniferous age rich in K-feldspar

Finally, based on the composition (Fig. 5), the analyzed sandstones of the Boeothian Flysch can be referred to the litharenite litharenite group (*sensu* Folk 1974; mean composition $Q_{40.9}F_{5.4}L_{53.7}$).

In addiction, the analyzed rocks usually show a middle-low textural maturity, testified by the sub-angular to sub-rounded shape of the grains, by a very poor sorting and by the presence of locally abundant siliciclastic matrix. These characters strongly points to very short transports, probably related to a rugged topography, as a consequence of a very unstable tectonic setting, and to a location of the sedimentary basin very near to the source areas.

In particular, with regards to the siliciclastic matrix, thin section analysis gives strong evidences

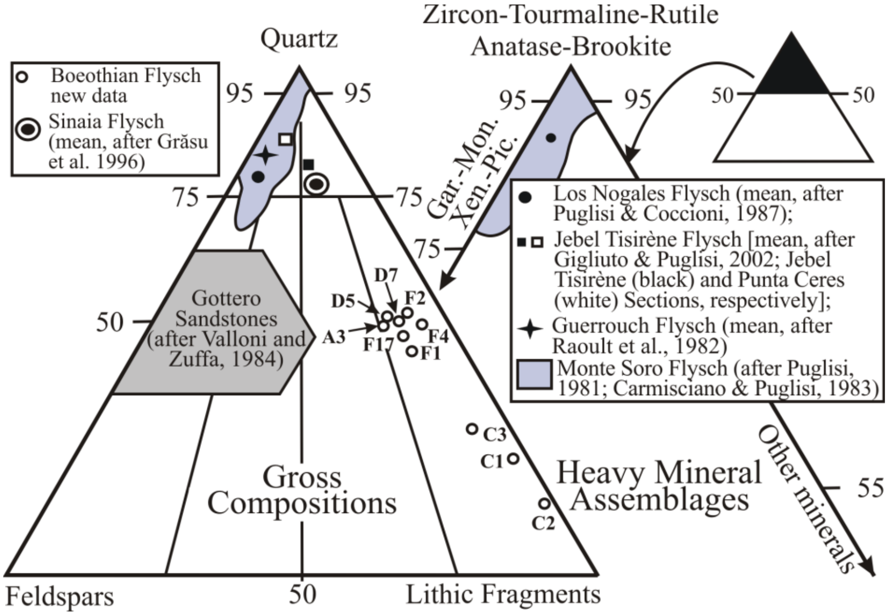


Fig. 5. Quartz-Feldspar-Lithic Fragment and Heavy Mineral Assemblage ternary plots showing the gross co-mposition characterizing the sandstones of the Early Cretaceous Maghrebian flysch (i.e. Los Nogales, Tisirène, Guerrouch and Monte Soro Flysch), northern Apennines (Gottero Sandstones) and eastern Carpathians (Sinaia Flysch). The data of the heavy mineral assemblages available in literature only regard two Early Cretaceous Maghrebian flysch (i.e. Los Nogales and Monte Soro Flysch; Puglisi, 1981; 1987; Puglisi and Coccioni, 1987). Heavy Mineral Assemblage abbreviations: Gar= garnet, Mon= monazite, Xen= xenotime and Pic= picotite).

Table 2. Quartz-Feldspar-Lithic Fragment detrital modes of arenites of Early Cretaceous flysch from Betic-Maghrebian Chain, northern Apennines and eastern Carpathians.

	Jebel Tisirène Flysch (Rif, Morocco; Gigliuto and Puglisi, 2002)						Los Nogales Flysch (Puglisi & Coccioni, 1987)		Guerrouch Flysch (Raoult et al., 1982)		Monte Soro Flysch (Gigliuto and Puglisi, 2002)				Monte Soro Flysch (Puglisi, 1981; Carmisciano and Puglisi, 1983)		Gottero Sandstones (Valloni and Zuffa, 1984)	Sinaia Flysch (Grasu et al., 1996)
	Jebel Tisirène Section				Punta Ceres Section		Betic Coirdillera (Spain)		Algeria		Sicilian Maghrebian Chain						Northern Apennines	Eastern Carpathians
	Calcareous turbidites (n= 5)		Arenaceous turbidites (n= 7)		Arenaceous turbidites (n= 8)		Arenaceous turbidites (n= 11)		Arenaceous turbidites (n= 16)		Calcareous turbidites (n= 50)		Arenaceous turbidites (n= 17)		Arenaceous turbidites (n= 33)		Arenaceous turbidites	Arenaceous turbidites
	x	σ	x	σ	x	σ	x	σ	x	σ	x	σ	x	σ	x	σ	x	x
Q	17.5	4.95	79.3	6.98	88.1	6.24	78.6	7.23	83.8	13.8	11.7	3.55	85.0	4.23	82.2	5.61	51,0	76.5
F	2,3	1.37	6.2	1.84	9.9	2.69	15.5	5.71	13.1	6.22	0.2	0.27	13.7	3.06	13.8	4.15	39.0	10.5
L	80.3	9.53	14.5	5.13	2.0	1.23	3.9	2.75	3.1	2.31	88.1	7.38	1.3	0.35	4.0	2.12	10.0	14.0
	100.0		100.0		100.0		100.0		100.0		100.0		100.0		100.0		100.0	100.0

Q, F and L= total Quartz, Feldspar and Lithic Fragment grains. x and σ = average and standard deviation, n = number of analyzed samples (modified after Puglisi, 2009).

that the infilling of the interstices often represents the result of mechanical compaction, crushing, deformation and squeezing of pelitic and also of metavolcanic rock fragments. Thus, this intergranular material can be partially ascribed to a pseudomatrix-like product (*sensu* Dickinson, 1970), commonly believed to represent a diagenetic product derived from the deformation of the weaker lithic fragments, which become partially, or exclusively, a typical siliciclastic matrix.

In table 2 and Figure 5, the detrital modes of the Boeothian Flysch are compared to those of Maghrebian Early Cretaceous flysch (Jebel Tisirène, Guerrouch and Monte Soro Flysch), of Late Cretaceous turbidites of northern Apennines (Gottero Sandstones) and of the eastern Carpathians Early Cretaceous Sinaia Flysch.

In particular, the Q-F-L ternary plot clearly displays the different gross compositions between the above-mentioned Early Cretaceous flysch, closely related to different source rocks.

The most different character is the absence of ophiolitic supply in the Early Cretaceous Maghrebian flysch. The Maghrebian Basin, in fact, seems to have been mainly developed on thin continental crust and, locally, it experienced only a partial oceanization, as testified by the occurrence of Middle to Upper Jurassic slices of basic rocks with an E-MORB affinity, scattered in the Rifian Chain (Morocco) and in Sicily (Durand-Delga et al., 2000). Otherwise, the other sectors of the Alpine Tethys reached real oceanic conditions, testified by ophiolitic slices, olistoliths or slide-blocks, included within the Cretaceous sedimentary deposits of the Ligurian-Piedmont Basin.

4. Conclusive remarks

Detrital modes of the sandstones of the Boeothian Flysch suggest a provenance from the internal domains, which can be identified with the Hercynian crystalline Pelagonian terranes and their Mesozoic carbonate covers and with ophiolitic complexes.

According to many Authors (Robertson and Mountrakis, 2006, and references therein), in fact, the Pelagonian zone is commonly interpreted as a Hercynian continental fragment of Gondwanan affinity (Mountrakis, 1986; 2006), covered by a thick and widespread Mesozoic carbonate platform. Ophiolitic nappes were detached onto this platform, starting from Late Jurassic up to Middle Cretaceous times, as a consequence of obduction processes occurred in the western margin of the adjacent Vardar Ocean (Eohellenic orogenic phase, Auct.).

In particular, the ophiolite-like detritus can tentatively be related with the so-called Pindos-Vourinos-Othris Ophiolites (Robertson and Mountrakis, 2006), derived from the western side of the Vardar Ocean (Fig. 2) and overthrust thick platform carbonate sequences of the Pelagonian microcontinent during Middle-Late Jurassic times (pre-Kimmeridgian, Brown and Robertson, 2004), rather than with the Vardar-Axios Ophiolites. These last, in fact, also closely connected to the above-mentioned obduction processes, which prelude the imminent closure of the Vardar Ocean, seem to have been tectonically emplaced onto the Pelagonian massif during Cretaceous times (Van Hinsbergen et al., 2005, and references therein), slightly later the deposition of the Early Cretaceous Boeothian Flysch.

Furthermore, contribution from Mesozoic carbonate sources is testified by the abundance of carbonate clasts, whose litology, together with the rare occurrence of sponge fragments (*Cladocoropsis* cfr. *Mirabilis* FELIX, Fig. 4b), suggest a provenance from a widespread carbonate platform. In fact, the informal name of “Cladocoropsis limestones” (or “Cladocoropsis Zone”) has long been used through the Dinaride and Hellenide Chains (Turnsek et al., 1981 and Scherreiks, 2000, respectively), and in particular within the Pelagonian Zone, to represent reefal limestones, as remnants of a widespread Jurassic platform.

Finally, low-rank metamorphic detritus (mainly phyllite and quartzite clasts) has always been recognized in the sandstones of the Boeothian Flysch. These clasts can be derived from the phyllites and quarzites of the Permian-Early Triassic metaclastics of the western Pelagonian margin (Mountrakis, 1986).

Moreover, we consider that part of the western margin of the Pelagonian microcontinent (i. e. the Boeothian and Parnassos domains), which remained uncovered by ophiolite nappes, formed the foreland basin system (*sensu* DeCelles and Gilles, 1996) of the orogeny.

During Early Cretaceous times, in fact, the Boeothian domain corresponded to the foredeep depozone of the foreland basin system, filled by material derived from the erosion of the emerged ophiolites and its Pelagonian basement, whereas the Parnassos domain, west of the Boeothian foredeep, could correspond to the forebulge depozone of the same system, separated from the Apulian continent by a westernmost small oceanic strand of the Pindos Ocean, as a probable backbulge.

The following westward migration of the orogeny is marked by the Paleogene flysch of the Parnassos area, which started when this zone was transformed into a foredeep depozone.

In conclusion, on the basis of the detrital modes, provenance and tectonic framework of the Boeothian Flysch, we emphasize its belonging to the Early Cretaceous flysch family, cropping out along all the western and central Europe Alpine Chains, from the Gibraltar Arc to the Balkans.

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