bonate. The mineral composition of sediments and internal fabric of individual minerals indicates that the muscovite-biotite bearing-granites can be considered a potential source rock.

Particular lithofacies and ichnofossils were studied to understand of the original deposition environment. Studied drill cores contain features which can be interpreted as reflection of both terrestrial and marine influences. Studied deposits were most likely deposited under strong influence of fluvial environment (braided river?). Terrestrial environment was assumed by an absolute majority of previous authors (Dvořák, 1998; Skoček, 1980; Zádrapa et al., 1983 etc.). Trace fossils helped to trace the marine influences in sedimentation (Mikuláš and Nehyba, 2001). The depositional environment was in the studied case affected by the marine conditions in its marginal or distal areas (interdistributary area, braided delta ?), probably during reduced fluvial supply or channel shifting. Shallow marine condition can be assumed.

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Latest Precambrian – Carboniferous Plate Tectonics of the Circum-Carpathian Area.

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The supercontinent Pannotia (Dalziel et al.,1994) was assembled during the latest Precambrian as a result of the Pan-African and Cadomian orogenies. Both Gondwana and Baltica were included in this supercontinent. The Cadomian orogeny in Gondwanian Europe is a continuation of the Precambrian Pan-African event. This orogeny caused deformation and magmatic events of terranes from Iberia through Armorica, Saxoturingian zone in Germany, Bohemian, Brunovistulicum and Małopolska massives, Carpathians to the Transcaucasus area (Golonka, 2000). The Baltica (Eastern Europe) might have collided with the Cadomian part of Gondwana during the Vendian time causing deformation in the Timan area and proto-Uralian area. The Pechora-Timan belt and fragments of Ural, Novaya Zemlya and Taimyr are equivalent of the Cadomian belt. The discussion about the Baltican or Gondwanian affinities of Brunovistulicum and Małopolska Terranes is perhaps irrelevant. Gondwana and Baltica formed one supercontinent, separation took place around the Precambrian-Cambrian boundary. The Cambrian could display characteristics of both Baltica and Peri-Gondwana. The MT and BV terranes could have had a the different location within Peri-Gondwanian or Avalonian realm as well as different Early Paleozoic history. Together they joined the Continent of Laurussia prior to the Variscan orogeny.

Advanced seafloor spreading occurred in the Iapetus--Tornquist ocean between Baltica and Gondwana during the Cambrian time. Baltica moved northward and rotated. The south-dipping subduction developed along the central margin of Gondwana in Late Cambrian - Early Ordovician time. It caused the onset of rifting of the Avalonian terranes (Golonka, 2000). Avalonia probably started to rift from Gondwana and move towards Baltica in the Late Tremadocian and was in a drift stage by the Llanvirnian. Avalonia was probably sutured to Baltica by the end of Ordovician or in the Early Silurian (Torsvik et al., 1996). The closure of the Tornquist Sea was dominated by a strike-slip suturing of the two continents, rather than by full-scale continent-continent collision.

Between Gondwana and Avalonia, a large longitudinal oceanic unit, known as the Rheic Ocean was formed. After the collision of Avalonia with Baltica the southward dipping subduction developed along the new margin of Gondwana. According to Stampfli et al. (2001) this subduction triggered detachment of the new Armoric or Gothic group of terranes during the Late Silurian. At the same time after the complete closure of the Iapetus Ocean, the continents of Baltica, Avalonia, and Laurentia formed the continent of Laurussia. During the Devonian Gondwana drifted northward and rotated clockwise (Golonka, 2000). The Armoric (Gothic) terranes began to arrive at the Laurussia margin during Devonian time. Early to Middle Devonian convergence is detected in the Mid-German crystalline high terrane and in the Bohemian Massif in Central Europe. Collisional activities were also detected in the Alpine-Carpathian area. The contact between Laurussia and Gothic terranes marks the onset of Hercynian orogeny. The Bohemian, Saxoturingian and Małopolska High domains (Lewandowski, 1998) moved along the strike-slip faults towards Laurussia. The Hercynian orogeny in Europe was a result of collision of several separate blocks with the Laurussia margin, followed by the involvement of Gondwana continent. Moesia, Rhodopes and the Alcapa superterrane which includes Eastern Alps, Inner Carpathian, Tisa and adjacent terranes, were sutured to the Laurasian arm of Pangea, while Adria and adjacent terranes were situated near the Gondwanian (African)arm. Late Carboniferous events were also marked in the Alps and Carpathians (Rakuš et al., 1998). The basement of most of the plates, which play important role in the Mesozoic-Cenozoic evolution of the circum-Carpathian area was formed during the Late Paleozoic collisional events. The older, Cadomian and Caledonian basement elements experienced Hercynian tectonothermal overprint.

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Permian-Early Cretaceous Opening of the Carpathian Basins

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Many of the continental collisions, which began in the Carboniferous, reached maturity in the Early Permian. A major part of Pangea was assembled, and the new supercontinent, ringed by subduction zones, moved steadily northwards. North-dipping subduction developed along the Paleotethys margin. The oceanic system was established in Southern and Central Europe during the Permian-Triassic time. The narrow branch of Neotethys separated the Apulia-Taurus platform from the African continent. The Vardar-Transilvanian Ocean separated the Tisa (Bihor-Apuseni) block from the Moesian-Eastern European Platform (Săndulescu, 1988) and its embayment presumably existed between Inner Carpathian and European Platform (Golonka, 2000; Golonka et al., 2000). The embayment position and its relation to the other parts of Tethys, Vardar Ocean, Meliata-Halstatt Ocean, Dobrogea rift and Polish-Danish Aulacogen remain quite speculative. According to Rakús et al. (1998) two oceanic units were located south of the Inner Carpathian plate. One was open during the Triassic time, closed during the Late Triassic as a result of the Early Cimmerian collision. Another, represented by sequences at the classic profile of Meliata in Southern Slovakia opened during the Early-Middle Jurassic as a back-arc basin and closed during Late Jurassic time. The position of the Meliata Ocean, time of closing and a role of the Tisa unit in the Mesozoic collisional events is still the subject of lively discussion.

Continued seafloor spreading occurred during the Jurassic time within the Neotethys. The Neotethys Ocean was divided into northern and southern branches. The Ligurian Ocean, as well as the central Atlantic and Penninic Ocean were opening during the Early-Middle Jurassic. The oldest oceanic crust in the Ligurian-Penninic ocean is dated as late Middle Jurassic. The Pieniny data fit with the supposed opening of the Southern Penninic Ocean basin (Golonka et al., 2000). Birkenmajer et al. (1990) postulate the earlier - Triassic opening of the Pieniny Klippen Belt Ocean. The Triassic pelagic limestones are known only from exotic pebbles transported from the enigmatic Exotic Andrusov Ridge.

Stampfli et al. (2001) recently postulates single Penninic Ocean separating Apulia and Eastern Alps blocks from Eurasia. We proposed similar model for the Pieniny Klippen Belt Ocean in the Carpathians. The orientation of the Pieniny Ocean was SW-NE (see discussion in Golonka and Krobicki, 2001). This ocean was divided into the northwestern and southeastern basins by the midoceanic Czorsztyn Ridge. The deepest part of the southeastern basin is documented by deep-water Jurassic-Early Cretaceous deposits (radiolarites, Maiolica pelagic limestones) of Złatna unit (Golonka and Sikora, 1981) later described also as Branisko-Pieniny unit or Vahicum (e.g., Plašienka, 1999). The shallowest ridge sequences are known as the Czorsztyn Succession with typical Tethyan facies (e.g., Fleckenkalk/Fleckenmergel, crinoidal limestones, red nodular ammonitico rosso-type limestones, Scaglia rosa marls). The deepest part of the northwestern basin is represented by deep-water, strongly condensed Jurassic-Early Cretaceous deposits (especially radiolarites and Maiolica facies) of the Magura (or Grajcarek or Hulina) unit (Golonka and Sikora, 1981; Birkenmajer, 1986; Golonka et al., 2000). Ridge sequences as well as transitional slope sequences are also called Oravicum (e.g., Plasienka, 1999).

In the Alpine-Carpathian area the subduction of the Meliata-Halstatt Ocean and the collision of the Pelsonian block with the Inner Carpathian terranes was concluded at the end of Jurassic. Major plate reorganization happened during the Tithonian time. The Central Atlantic began to propagate to the area between Iberia and the New Foundland shelf. The Ligurian-Pieniny Ocean reached its maximum width and stopped spreading. Subduction jumped at this time to the northern margin of the Inner Carpathian terranes and began to consume the Pieniny Klippen Belt Ocean (Birkenmajer, 1986, 1988). The Outer Carpathian rift (Silesian Basin) was accompanied by the extrusion of basic lavas (teschenites) in the Western Carpathian and diabase-melaphyre within the „black flysch“ of the Eastern Carpathians.

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