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From Extension to Inversion – Sedimentary Record of Mesozoic Tectonic Evolution within the Marginal Fault Zone, SE Mid-Polish Trough

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The Mid-Polish Trough (MPT) belonged to a system of epicontinental depositional basins of western and central Europe and formed the SE axial part of the Danish–Polish Basin (Ziegler, 1990). It developed from Permian to Cretaceous times and was filled with several kilometres of sediments, mainly siliciclastics and carbonates (e.g., Kutek, 2001). The MPT was located along the NW–SE-trending Tornquist–Teisseyre Zone. It stretched from the Baltic Sea towards the SE and, from the Jurassic onwards, it also included the area of the present E Carpathian Foredeep basin (cf. Hakenberg and Świdrowska, 1998; Kutek, 2001). The MPT was inverted in the Late Cretaceous – Paleocene times, at which time its axial part was strongly eroded (Ziegler, 1990). In its SE part (Holy Cross Mts. and Małopolska Massif), its Palaeozoic basement was exposed as a result of this inversion. Within the SE Mid-Polish Trough (NE margin of the Holy Cross Mts. area), tectonic structures responsible for MPT's extension and inversion were recently revealed on high-quality petroleum seismic data (Krzywiec, 2002). They form a typical system of inverted normal faults, with their SW parts characterized by significantly increased thickness of Mesozoic (mainly Upper Jurassic) deposits related to their extensional activity. Inversion structures are accompanied by thickness reductions and progradational patterns within the Upper Cretaceous deposits. Such features are typical for syn-depositional tectonic activity. Thickness reduction above the uplifted basement blocks, local erosion and relatively short distance of sediment supply resulted in thickness reductions and progradational pattern in close vicinity of master reverse faults.

Stratigraphic data derived from the well cores, neighbouring outcrops and regional interpretations (e.g., Gutowski, 1998; Kutek, 2001) combined with the seismic interpretation allow to recognize the following succession of tectonic/depositional events along the NE margin of the MPT's Holy Cross segment:

- Permian – Triassic: initial extension stage connected with possible deposition of continental clastics followed by uplift and erosion
- Early – Middle Jurassic (Pre-Bathonian?): extension interrupted by minor uplift. As sediments older than the Oxfordian are absent or of very low thickness along the investigated seismic line, a more detailed interpretation is not possible.
- Late Jurassic: major extension and subsidence, recorded by the Oxfordian (Bathonian?)–Kimmeridgian sedimentary sequences, especially by the relatively thick Middle Oxfordian – Lower Kimmeridgian highstand systems tract, the thickness of which rapidly increases within the SW limb of the marginal fault.
- post-Tithonian – pre-Late Valanginian: uplift recorded by stratigraphic gap and/or subtle angular unconformity between the Upper Kimmeridgian (locally up to the Lower Kimmeridgian Divisum Zone) and the Upper Valanginian successions.
- Early Cretaceous: possibly prevailing extension/subsidence interrupted by minor uplift events as indicated by thickness of the Upper Valanginian – Middle Albian succession increasing towards the NW, including some sedimentary discontinuities.
- post-Middle/pre-Late Albian: major uplift resulted in sedimentary discontinuity and correlative erosional gap which underlie the Upper Albian transgressive sediments. Relevant erosion locally removed the Lower Cretaceous sediments and even cut the Kimmeridgian sequence down to the Divisum Zone sediments.
- Late Albian – Early(?) Turonian: extension related to the increased thickness of the relevant sequence within the SW limb of the marginal fault.
- Late(?) Turonian – Maastrichtian: inversion of the marginal fault resulted in NE-directed progradation of the Upper(?) Turonian – Maastrichtian succession and its significantly greater thickness in the NE limb of the marginal fault.

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New Saharan Find: Arondrite of Lunar Origin

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Introduction

Over twenty meteorites have been identified as being of lunar origin. The find site in the Libyan Sahara is one of the richest lunar meteorite locality in recent time. We report on the recovery of a new achondrite from Libya. This stone (6 g) was collected in the wadi Zam Zam area in year 2000. It is a dark grey unbrecciated basaltic stone with incomplete fusion crust. We present here the first results of mineralogical and petrological studies.

Mineralogy, Petrology and Composition

A small piece of the original meteorite was studied by mineral analysis (quantitative analyses and backscattered electron images – BSE were obtained using CamScan S4 electron microscope with Link ISIS 300 analytical system at Charles University, Prague) and bulk chemistry was studied using compositional methods (INAA, fused-beam EMP). The meteorite is a ***low-Ti olivine mare basalt*** with crystalline porphyritic texture. The modal mineralogy, as determined by EMP mapping and point counting, is: 25.3 % olivine, 52.2 % pyroxene, 17.4 % feldspar (maskelynite), 3.1 % opaques (mainly ilmenite and spinel), <1 % silica, <1 % impact melt.

Olivine occurs in anhedral to subhedral grains ranging up to 300 μm across with composition from Fa_{38} to Fa_{62}, mean Fa_{47}, commonly with ilmenite and chromian-spinel inclusions. Matrix is composed of coarse-grained pyroxene, which varies in composition from pigeonite Wo_{11-20} En_{2-70} to augite Wo_{25-38}

Fig. 1. Major element composition of pyroxenes plotted onto pyroxene quadrilateral and composition diagrams for olivine and plagioclase (left). FeO/MnO ratio of pyroxenes and bulk sample (right). BSE image displaying the porphyritic texture (upper right).