Style of folds in turbidites in part of the Circum-Rhodope Belt, Thrace region, Northern Greece

Стил на гънки в турбидити в част от Циркум-Родопския пояс, област Тракия, Северна Гърция

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An isolated small area at the Aegean Sea coast south of the town of Komotini in Thrace region of northern Greece was assigned to the sequence of Mesozoic rocks (mainly Triassic to Middle Jurassic) exposed across the north Aegean (Bornovas, Rhondogianni-Tsiambaou, 1983) which belongs to the Circum-Rhodope Belt (Kauffmann et al., 1976) (Fig. 1). Previous studies in this so-called Fanari area identified a turbiditic succession (Bonev et al., 2009) that underwent strong deformation resulting in multiphase folding and northward shearing (Bonev, Stampfli, 2011). Here we provide additional details on the fold style of the turbiditic succession in the Fanari area.

The sedimentary succession displays sandstone and shale beds in a bulk rhythmic alternation that defines a fragment of a turbidite system. Generally, medium-thick beds within the succession demonstrate a partial Bouma sequence, with most commonly ob-

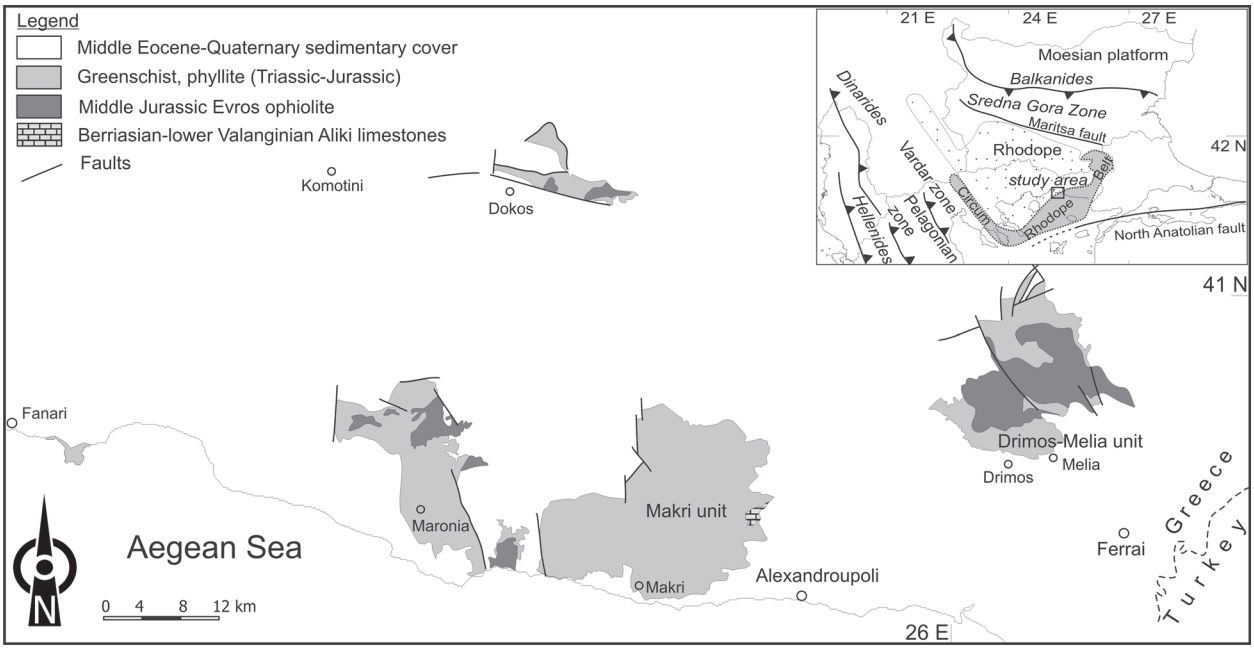

Fig. 1. Simplified map of a part of the exposed areas of the eastern Circum-Rhodope Belt in Thrace region, Northern Greece (modified from Bonev and Stampfli, 2011)

served graded lamination at the base of stratification and progressively upward parallel lamination and current ripple lamination and dish flow structures, all characteristics pertinent to turbidites.

The folds in the turbiditic sedimentary succession belong to two generations (Bonev, Stampfli, 2011). Rarely observed F_1 folds are tight to isoclinal small folds that deform the bedding S_0 which is transposed into S_1 slaty cleavage and/or domainal schistosity, where F_1 folds become intra-folial with typically $S_0//S_1$. The F_1 folds are coaxially refolded by larger folds F_2 reaching up to several meters, dominating the structural pattern and changing in style, namely the geometry and orientation (e.g. Marshak, Mitra, 1988). The F_2 folds range from open to tight rounded flexural-slip parallel folds, subrounded similar folds and angular to chevron folds. The F_2 folds vary from recumbent to steeply inclined and their axes gently plunge to NE and SW. The F_2 folds associate with moderately to steep mainly SE-dipping axial-planar S_2 cleavage that has chracteristics of mostly sericite-defined slaty cleavage and/or crenulation cleavage. Commonly, the S_2 cleavage is materialized by quartz-calcite vein fillings propagating in the F_2 axial planes. The lithological heterogeneity of the turbidite sequence has provoked the refraction of the axial-planar cleavage S_2 that is penetratively developed only in the shaly layers and is very scarce and/or expressed by the local occurrence of fracture cleavage in the sandy layers. The S_2 cleavage fans across the profile of the F_2 folds where planar structures are typically $S_0//S_1//S_2$ in the F_2 fold limbs. There a mineral (quartz, calcite and detrital grains) fibers lineation tracks flexural-slip across the profiles of the F_2 folds that in turn show pronounced NW vergence. The F_2 folds have sheared limbs along the metre-scale fold-propagating thrusts and/or shears, which have accommodated north-northwest directed displacement and progressive overturning of the F_2 folds. The outcrop and thin section observations revealed crystallization of sericite and chlorite mineral assemblage along the S_1 foliation, indicating a lower greenschist-facies metamorphic conditions during the deformation of the turbidites. In the sandy layers the F_2 folds hinges also show locally the development of conjugate brittle fractures, which suggests rheologic decoupling of the competent and ductile layers at low temperature conditions during the folding and bulk deformation of the turbidites.

The fold style, associated structures and metamorphic grade observed in the Fanari area turbidites are similar to those reported from larger exposures in the Circum-Rhodope Belt such as in the adjacent Makri unit further east (e.g. Bonev, Stampfli, 2011). The complementary deformational data obtained from the Fanari area turbidites are thus in accordance with previous results from the eastern part of the Cicrum-Rhodope Belt.

An open question that still regards the Fanari turbidites is their depostional age which needs to be determined because of the critical position of the turbidite succsession between the westerly and easterly exposed parts of the Circum-Rhodope Belt as a whole, where Permian–Late Jurassic depositional data of the sediments have been reported (Meinhold et al., 2009, 2010). The depositional history of the Fanari turbidites may help to establish temporal constraints on the sedimentation linked to the development of the early Mesozoic margin at Eurasia.

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