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Preliminary tectonostratigraphy results from the Small Trocharis mountain, north-east Lefka Ori, western Crete

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Highlight

Here we describe our mapping results, for the updated stratigraphy of the Plattenkalk unit, and the tectonic contacts in Small Trocharis Mountain at north-east Lefka Ori of the island of Crete. The most prominent finding is that in the north-east, close to the peak of Ag Pneuma Melidoniou the thin bedded marble with silex (upper Jurassic-Eocene) is overlain by the upper Triassic to lower Jurassic white marble (Plattenkalk unit, both) and the contact between them appears as a primary conformable depositional contact. The previous shows a possible overturned structure.

Background and Objective

Nikolaidis *et al.* (2013) estimated the capacity of the karstic aquifer at $500 \times 10^6 \text{ m}^3$ for the Koiliaris watershed and the associated extended karstified area outside the watershed. The extended karst area is delineated in the region of the two deepest caves (sinkholes) in Greece, the Lontari (1100 m deep) and the Gourgouthakas caves (1208 m deep). Our study covers the extended karstic watershed. The objective of this work, under the IGCP-715 project, is to update our existing understanding of the geological model in the area and as well as to provide detailed lithological and structural insights for the extended karst area.

Geological Setting

The lithostratigraphy of Crete has been described by Fytrolakis (1980), Soujon *et al.* (1998), Manutsoglu *et al.* (2003), Fassoulas & Nikolakakis (2005) and Papanikolaou *et al.* (2010). The western part of Lefka Ori area is characterized by a non-overturned continued sequence of Plattenkalk unit (Manutsoglu *et al.*, 2003, IGME 1972, Vrisses sheet, 1:50,000). The general stratigraphy from old to young is: (1) Lias stromatolitic, dolomitic marble (Mavri formation), (2) The upper Jurassic Gigilos beds (marble with schist and chert), (3) the upper Jurassic to Eocene thin bedded marble with silex (also called *Typical* Plattenkalk), and (4) the Oligocene metaflysch (Kalavros layers-limeschists; Manutsoglu *et al.*, 2003). The Triassic to Jurassic Trypali unit is mainly recrystallized marble and appears to overlay with a thrust at different age formations of the Plattenkalk unit. In the Vrisses sheet (1:50,000), the Lias stromatolitic is missing and a white-grey limestone is alternating with very karstified black dolomite of the same age.

Results-Area 1 and Area 2

We have mapped 4 different formations of the Plattenkalk unit in the Small Trocharis mountain (area 1) and Ag Pneuma Melidoniou (area 2) as it is shown in Figure 1a. From top to bottom in the stratigraphy column we have identified (1) white marbles of the Plattenkalk unit (W1) alternating with grey brecciated dolomite (BrD2) sometimes not only vertical but also within cavities, thus we consider it as one formation WI+BrD2, (2) black and white alternating stromatolitic dolomitic layers which are dipping SE (Str), which are not described in the Vrisses sheet (1:50,000) (3) black massive dolomite alternating with brecciated dolomite (BrD1). In the area around Gourgouthakas cave, WI+BrD2 is reappearing and the nature of the contact between the BrD1 and WI+BrD2 has not yet clarified (Figure 1b). At Ag Pneuma Pemoniano chapel (close to area 1), there is the tectonic contact of the Trypali unit (Tr) in the hangingwall and the Ca-phyllites of the thin bedded marble (Plk) in the footwall, however, we were not able to identify the tectonostratigraphic relationship of the youngest Plk with the older formations of the Plattenkalk unit in the area 1 (WI-BrD2, Str, BrD1). The Plk are dipping towards NE with very shallow dipping angle (12-17°). On the contrary, in the area 2, the Plk is overlain by the WI+BrD2 (Figure 1c). The measured faults in the area are striking E-W and NW-SE and they are characterized as thrust and normal faults, respectively.

Interestingly, in the area 2, the younger formation of the Plattenkalk unit, the thin bedded marble with silex (Plk) is overlain by the white marble (WI+BrD2) (Figure 2a, 2b and 1c). We were able to measure the dipping of the Plk which dips NE with 30°. The contact appeared sedimentary conformable (Figure 2a, 2b). This is the first time we observe in western Crete the Plk to be overlain by the WI+BrD2 and that denotes a possible overturned structure. The same observation has been reported also from the 2022 expedition in Gourgouthakas cave (Unpublished data).

Area 3 and Area 4

Area 3 is in the road to Ag. Pneuma Melidoniou and area 4 in Gournes valley (Figure 1a). A thrust contact between the Trypali Unit (Tr) (hanging wall) above the Plattenkalk (footwall) has been described. The thrust dips to the NE with an angle of 30°. The Trypali unit is strongly tectonized. The Plattenkalk unit dips shallowly to the NE. In the area 3, the thrust shows evidence of reactivation as normal fault, probably related with later than the thrust, extensional phase.

Conclusions

We have identified four formations at Small Trocharis mountain, and we described the stromatolitic layers and their stratigraphic position relative to the other formations in north Lefka Ori. East of the deep caves the younger formation Plk of the Plattenkalk unit appears stratigraphically below the older formation WI+BrD2 of the Plattenkalk unit. The previous denotes an overturned structure which has been observed also at Gourgouthakas cave at equivalent elevation of 1260 m. Further petrographic analysis will be used to correlate with the tectonostratigraphy of the central Crete.

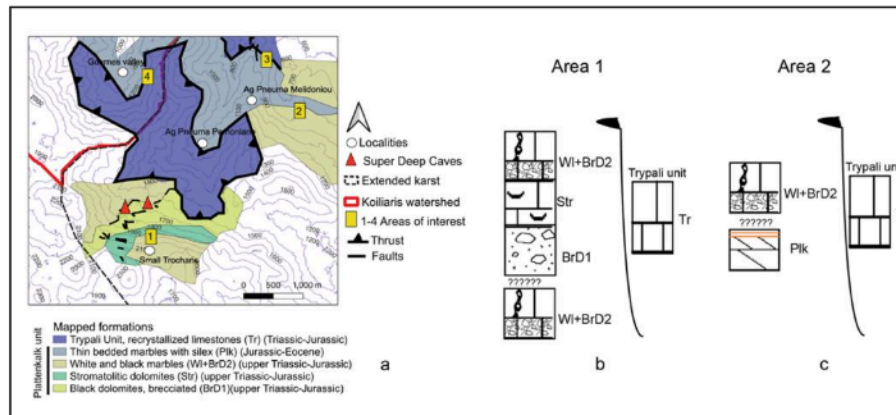


Figure 1. a) Mapping results and the identified lithologies. IGME 1972, Vrisses sheet 1:50,000 has been also utilized to identify the extend of the mapped lithologies. Contour elevation in meters and contour interval 100 m. b) stratigraphy column in area 1. c) stratigraphy column in area 2, below the contact the thin marble change to Ca-phyllite.

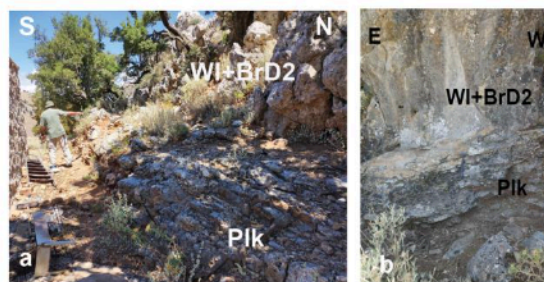


Figure 2. a) White limestone with pockets of dolomitic breccia (WI+BrD2) overlay the thin bedded limestones with silex (PIk) in the area 2. b) Close view of the white limestone (WI+BrD2) which overlies PIk in the area 2.

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