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Metamorphosed hemi-pelagic evaporites in Anatolia: a Mid-Cretaceous salinity crisis in the Neotethys?

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Calcified, formerly meta-evaporitic successions were recently identified in the mid- to Late Cretaceous hemi-pelagic stratigraphic sequence of a subduction-related metamorphic belt in western Anatolia. Up to eight classical structural categories of gypsum, including delicate textures like swallowtail-twins, were recognized in the so-called 'Rosetta Marble', supporting the concept of a gypsum precursor. Individual meta-gypsum crystals, forming all together radiating aggregates, are up to 1.5 m in length, which suggests high salinity levels under stable environmental conditions. These findings have opened perspectives toward quantitative assessment of the palaeogeographic, palaeoenvironmental, and palaeoclimatic settings that prevailed during the deposition of hemi-pelagic evaporite in the closing Neotethys realm.

Up-to-km–thick meta-evaporitic-sequences are retrieved at several localities from southwestern to central Anatolia. Cretaceous Rosetta Marble consists of interbedded marble and radiolarites (Figure 1) that were buried in a subduction zone around the Cretaceous–Palaeogene boundary. The exceptional preservation of gypsum morphologies despite subduction-related metamorphism suggests a direct transformation from gypsum to calcium carbonate (most likely aragonite), by a thermochemical sulphate-reduction. Massive amount of methane was therefore necessary to allow complete replacement of SO_4^{2-} by CO_3^{2-}. The absence of an anhydrite intermediate stage implies fast burial along a low geothermal gradient typical of subduction environments.

Isotope geochemical analysis was performed to investigate the depositional environment of this evaporitic succession. Oxygen, $\delta^{13}C$ and $^{87}Sr/^{86}Sr$ isotope analysis yields values typical of Cretaceous seawater. Primary geochemical fingerprints, as did crystal morphologies, have not been reset during diagenetic and metamorphic processes despite significant alteration. Carbon isotope data suggest that at least three different C-sources have been active during sulphate reduction.

The regional distribution of these rock-forming meta-evaporites in Upper Cretaceous hemi-pelagic sequences witnesses the existence of a previous unknown, large and deep marine basin. The formation of such massive evaporitic sequences requires

conditions similar to the Messinian salinity crisis.

Figure 1: Rosetta Marble (pseudomorphs after giant gypsum) alternating with meta-chert layers, SW-Turkey.