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Origin and occurrence of Anatolia's Rosetta marbles

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Anatolia's complex geology is characterized by several subduction-related, high-pressure, low-temperature (HP–LT) metamorphic belts. One of these belts, extending over several hundreds of kilometres from South-Western to Central Anatolia, represents parts of the northern Anatolide–Tauride microcontinent that were buried and exhumed during the closure of a Neotethyan oceanic branch during the Late Cretaceous and Early Cenozoic. The Anatolide–Tauride continental platform consists of a complete section of a passive continental margin, including a Precambrian–Palaeozoic substratum and its Triassic rift-related to Upper Cretaceous pelagic sedimentary cover. The latter are composed of metamorphic equivalents of silty to pure limestones (marbles) intercalated with cherts (meta-cherts).

Throughout the belt, the marbles show centimetre to metre scale rosette-like textures of calcite rods, so far not investigated in detail. Such textures are observed only in the pure parts of the sequence and develop in three dimensions within single beds. Each calcite rod is made of smaller calcitic fibres, pseudomorphs after aragonite, showing parallel orientation oblique to the rod axis and strontium content abnormally-high, only typical for aragonite. The fibres are in turn overprinted by even smaller and un-oriented calcite crystals. Quartz crystals associated with the calcite rods include aragonite (Raman spectroscopy).

Locally, well-preserved rosetta textures display selenite-like calcite rods, indicating they might be represent pseudomorphs after gypsum. However, no sulphate phases could be found in any lithology.

Radiolarian structures are found in meta-chert, and the imprint of rosetta textures are observed at the bottom of meta-chert beds. These features indicate that primary gypsum developed in a deep sub-tidial environment. This pleads for a restricted environment with sulphur-rich brines allowing gypsum precipitation. Complete extraction of sulphur to form the calcite rods implies a dramatic change of the geochemical environment prior to burial in the subduction zone. A possible agent for such a reaction could be a large supply of methane.

Our study thus provides several pieces of evidence for HP–LT metamorphism of the rosetta marbles: (1) Aragonite inclusions in quartz, (2) preserved characteristic fibres of aragonite pseudomorphs, (3) strontium contents abnormally high for the calcite lattice and (4) widespread index HP–LT mineral assemblages in metamorphosed Triassic clastic sediments. During rock exhumation, the aragonite fibres were pseudomorphed to calcite.

Therefore, a detailed stratigraphic, petrographic and chemical inspection of Anatolia's rosetta marbles allows us to distinguish syn-sedimentary from metamorphic crystal growth processes. We foresee that further investigations of these primary textures and pseudomorphs will allow a more detailed characterization of the northern margin of this Neotethyan domain.