

Prograde calcite to aragonite transformation in the Gümüşyeniköy micritic limestones (Tavşanlı, NW Turkey)

The micritic limestones (500–250 m in size, latitude 39°40′8.634″/longitude 29°44′38.332″) near the Gümüşyeniköy village (Tavşanlı, NW Turkey) preserve a unique example of prograde micritic calcite to aragonite transformation on the outcrop-scale (Figs. 1, 2; Okay 1982; Topuz et al. 2006). Aragonite is the high-pressure polymorph of CaCO_3 , but is rarely preserved in high-pressure metamorphic rocks owing to rapid reaction kinetics during decompression and/or heating (e.g., Gillet and Goffé 1988; Theye and Seidel 1993; Hacker et al. 2005). In exhumed high-pressure/low-temperature metamorphic rocks, aragonite may be preserved as inclusions in robust minerals such as zircon (e.g., Liu et al. 2004) and garnet (e.g., Chopin et al. 2008). Rod-shaped calcite is widespread in marbles of high-pressure areas and is interpreted as pseudomorphs after aragonite (e.g., Brady et al. 2004; Seaton et al. 2009). For the preservation of aragonite, it has been

suggested that the high-pressure metamorphic rocks should cross the aragonite to calcite reaction boundary during exhumation at low temperatures (e.g., $\leq 230^\circ\text{C}$) in the absence of fluids and pervasive deformation (e.g., Liu and Yund 1993). Such a combination of conditions is apparently rare.

The Gümüşyeniköy micritic limestones form part of a Late Cretaceous ophiolitic melange (Okay 1982; Topuz et al. 2006; Okay and Whitney 2010) and crop out over an area of 500–250 m as thinly to medium bedded (10–40 cm) carbonates. They are stratigraphically underlain by basalts with pillow structures. The limestones are quarried for local house construction (Fig. 1). Aragonitization has started in the central parts of the beds and proceeds to the upper and lower margins (Fig. 2). The reaction fronts between the primary micrite ($\leq 3\ \mu\text{m}$) and newly formed large aragonite crystals (up to 4 cm) are noticeable



Fig. 1 Village quarry near Gümüşyeniköy with partially aragonitized limestones

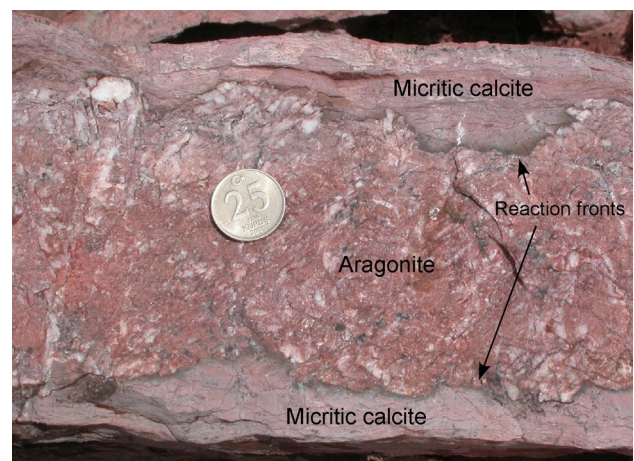


Fig. 2 A limestone bed with aragonitized interior and relict micritic margins. The coin is 2 cm across

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with the naked eye (Fig. 2). The amount of impurities (e.g., quartz, clay minerals, and Fe–Mn-hydroxides) increases from the central parts of the layers to the upper and lower margins, and this was probably responsible for initiation of aragonitization in the center of the beds. The P–T conditions of the aragonitization has been determined as 200 ± 50 °C and 0.45–0.65 GPa, based on the mineral assemblages in the amygdaloids and veins in the associated basalts (Topuz et al. 2006).

This GeoSite near the Gümüşyeniköy village (Tavşanlı, NW Turkey) is a unique and spectacular example of the prograde frozen calcite to aragonite transformation during subduction and of the perfect preservation of aragonite during exhumation.

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