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Carbonate pseudotachylite? from a Miocene extensional detachment, W. Cyclades, Greece.

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Most pseudotachylites, both impact- and fault-related, occur in silicate-rich rocks, typically with 'granitoid' compositions. Examples of melting in carbonate rocks, excluding magmatic sources, are restricted to impact-events, except for a carbonate pseudotachylite in the Canalone Fault, S. Italy (Viganò et al. 2011). Another potential example of carbonate pseudotachylite, shown here, comes from the Miocene-aged W. Cycladic Detachment System, in Greece. Top-SSE ductile to brittle movement on this detachment, with a maximum displacement estimated at tens of kilometers, exhumed of HP-rocks. The carbonate pseudotachylite occurs within an <200 mm thick zone of cataclasites developed between footwall carbonate ultramylonites, containing thin layers and cm-scale boudins of quartzite, and hanging wall breccias; no contacts with the footwall ultramylonites or hanging wall breccias has been found (yet). The cataclasite zone, which can be traced along-strike for at least 90 m, over ∼20 m elevation, comprises several distinct layers. In the sample described, five layers occur. The lowest (A; >43 mm thick), consists of dark (hematitic) red, ultra-fine grained unlayered carbonate with up to 40x10 mm rather rounded clasts of earlier generations of cataclasite, many with a quartzite composition. These clasts are fractured and partially separated, with a fine red carbonate matrix. No layering of the matrix or clasts is apparent. The clasts become finer and more abundant towards the boundary with Layer B. Layers B and D (∼57 & ∼20 mm thick) dominantly comprises protocataclasite with greyish quartz fragments separated by a carbonate matrix along narrow fractures. Zone C and E (∼23 m & >15 mm thick) comprise pale pink carbonate-dominated rocks with abundant <30x5 mm-sized red carbonate clasts (+/- quartz fragments) of earlier cataclasite generations. These elongate clasts lie parallel to the overall banding, which is parallel to the ultramylonitic foliation (detachment surface). Smaller clasts are markedly more rounded and comprise carbonate and quartzite material and may have darker (?reaction) rims. No layering is seen in the pale pink groundmass although this is present in some elongate clasts. All layer boundaries are irregular and no principle slip surfaces have been seen. Injection veins from 1 to 9 mm wide and up to at least 100 mm long derive from the central layer (C), cutting the overall layering at a high angle and branching in several places. These veins contain clasts comparable to those in Layer C. Both thick and thin injection-veins are rimmed by impersistent white calcite suggesting that injection was associated with precipitation of calcite. Whether Layer C (and perhaps E also) is a carbonate pseudotachylite is unknown. Although the injection veins are suggestive of this, these also occur in conjunction with ultracataclasites (Craddock et al. 2012). The irregular boundaries between the layers and the lack of any principal slip surfaces might indicate decarbonation and/or fluidization of gouge layer (Rowe and Griffith, 2015). Finally, abundant tubules, with rounded profiles and mostly sub-circular shapes up to 1.2 mm across, occur in Layers C and E, and less so D; these could be interpreted to reflect vents formed by partial carbonate degassing during melting.