Nature of the hydrothermal alteration in the Lesbos(Greece) petrified forest and its host pyroclastic rocks

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An early Miocene petrified forest is preserved in the Sigri Pyroclastic Formation of western Lesbos. The purpose of this research is to identify the origin of silicairon-manganese mineralization of the fossilized trees and their host rocks. The approach used is to identify mineral assemblages present in petrified wood, the altered Jithra ignimbrite, the altered fine-grained sedimentary rocks underlying the ignimbrite, and a nodule as well as yellow veins from a fault cutting tuffs. These minerals were compared with published work in other areas with similar minerals to determine their possible geological origin. A Scanning Electron Microscope and EDS chemical analyses were used to identify the minerals. The petrified wood shows cells filled with amorphous silica, followed by replacement of cell walls by silica, then a silica + Fe-oxide mixture, and finally Fe-oxide, in some cases with minor As and Zn, which are bioessential elements that may indicate microbial mediation. The fault zone nodule is mineralogically zoned. The inner zone is entirely microcrystalline or amorphous silica. The middle zone comprises a silica + Fe-oxide mixture with Mn-oxide aggregrates. The outer zone consists of host tuff partly replaced and cemented by Fe-oxides/hydroxides and the silica + Fe-oxide mixture. As the nodule was found in an altered fault zone, it may have been a pathway for hydrothermal solutions that first altered the country rocks in the outer zone and finished with the final filling by yellow silica veins. The altered ignimbrite and underlying finegrained sedimentary rocks exhibit more extreme alteration. Mineral assemblages in the altered ignimbrite are: (1) K-feldspar + silica? + illite + minor apatite, zircon, TiO_2 minerals; (2) jarosite + hematite + amorphous silica; and (3) Mn-oxides. Hydrothermal K-feldspar appears to have formed by replacement of volcanic glass, hornblende, and plagioclase crystals. Jarosite replaced hornblende already partly replaced by amorphous silica. Assemblages from the altered fine-grained sedimentary rocks are predominantly smectite + silica + TiO_2 minerals ± hematite ± monazite. Smectite was seen to replace crystals of biotite, plagioclase, and glass fragments. Among possible analogues in the literature, the epithermal system of the Taupo volcanic zone in New Zealand has a very similar setting to the Sigri Pyroclastics. The types of alteration produced by different circulating waters can be compared. However, the distinctive amorphous silica + Fe-oxides are chemically and mineralogically comparable with jaspers found in marine exhalative systems (e.g., Bathurst, Ireland). This observation is interesting because there is no evidence for nearby marine conditions in the Sigri Pyroclastics.

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