The Role of Randomly Mixed-Layered Chlorite/Smectite in the Transformation of Smectite to Chlorite

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Abstract: Vesicular and groundmass phyllosilicates in a hydrothermally altered basalt from the Point Sal ophiolite, California, have been studied using transmission electron microscopy (TEM). Pore-filling phyllosilicates are texturally characterized as having coherent, relatively thick and defect-free crystals of chlorite (14 Å) with occasional 24-Å periodicities. Groundmass phyllosilicates are texturally characterized as 1) randomly oriented crystals up to 200 Å in width and 2) larger, more coherent crystals up to 1000 Å in width. Small crystallites contain predominantly 14-Å layers with some 24-Å units. Large crystals show randomly interlayered chlorite/smectite (C/S), with approximately 50% chlorite on average. Adjacent smectite-like layers are not uncommon in the groundmass phyllosilicates. Electron microprobe analyses show that Fe/Mg ratios of both groundmass and vesicular phyllosilicates are fairly constant.

Termination of brucite-like interlayers has been identified in some of the TEM images. The transformation mechanisms represented by these layer terminations are 1) growth of a brucite-like interlayer within smectite interlayer regions and 2) the dissolution and reprecipitation of elements to form chlorite layers. Both mechanisms require an increase in volume as smectite transforms to chlorite.

The data, combined with that from previously published reports, suggest that randomly interlayered C/S is a metastable phase formed in microenvironments with low water/rock ratios. Chlorite forms in microenvironments in the same sample dominated by higher water/rock ratios. The relatively constant number of Mg's in the structure (Mg#) of both structures indicates that in both microenvironments the bulk rock composition has influence over the composition of phyllosilicates.

Key Words: Chlorite • Corrensite • Hydrothermal Metamorphism • Random Interlayered Chlorite/Smectite • Smectite • Transmission Electron Microscopy

Clays and Clay Minerals; August 1997 v. 45; no. 4; p. 506-516; DOI: 10.1346/CCMN.1997.0450403

Clay Minerals Society (www.clays.org)