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# Geology and Characterization of Two Hydrothermal Nontronites from Weathered Metamorphic Rocks at the Uley Graphite Mine, South Australia

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**Abstract:** Mining operations during the early 1990s at Uley Graphite Mine near Port Lincoln on southern Eyre Peninsula, South Australia, uncovered abundant nontronite veins in deeply weathered granulite facies schist, gneiss, and amphibolite of Palaeoproterozoic age. Two types of nontronite are present: a bright yellowish-green clay (NAu-1) distributed as veinlets and diffuse alteration zones within kaolinized schist and gneiss, and a massive to earthy, dark-brown clay (NAu-2) infilling fracture networks mainly in amphibolite or basic granulite. The nontronites are the product of low-temperature hydrothermal alteration of primary minerals, biotite, and amphibole. The principal chemical difference between NAu-1 and NAu-2 is a higher alumina content in NAu-1, which was either inherited during hydrothermal alteration of biotite in the host rock or acquired through recrystallization of nontronite during subsequent weathering and associated kaolinization. Sufficient bulk samples of both NAu-1 and NAu-2 were collected to supplement reference nontronite of the Source Clay Repository of The Clay Minerals Society. The clay fraction of the bulk samples is typically >85%. NAu-1 contains minor kaolin and quartz which are easily removed to give a high purity nontronite of composition  $M^{+}_{1.05}[\text{Si}_{6.98}\text{Al}_{1.02}][\text{Al}_{0.29}\text{Fe}_{3.68}\text{Mg}_{0.04}]\text{O}_{20}(\text{OH})_4$ , similar to that of nontronite from Garfield, Washington. NAu-2 contains fewer total impurities but the presence of trace amounts of submicron carbonate and iron oxyhydroxide requires additional chemical treatment to produce a nontronite of purity comparable to NAu-1. Composition of NAu-2 was calculated as  $M^{+}_{0.72}[\text{Si}_{7.55}\text{Al}_{0.45}][\text{Fe}_{3.83}\text{Mg}_{0.05}]\text{O}_{20}(\text{OH})_4$ , although infrared data indicate that at least some Fe is in tetrahedral coordination.

**Key Words:** Amphibole Alteration • Biotite Alteration • Hydrothermal Alteration • Infrared Spectroscopy • NAu-1 • NAu-2 • Nontronite • Weathering • X-ray Diffraction

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