Hisingerite Material from a Basalt Quarry Near Geelong, Victoria, Australia

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Abstract: A material resembling what has been described in the literature as hisingerite has been identified in the joints of Cenozoic grey basalt near Geelong, Victoria. The material gives an X-ray powder diffraction pattern with weak broad peaks at 4.49, 2.58, and 1.53 Å and a chemical analysis of SiO_2 = 34.2, TiO_2 = 0.28, Al_2O_3 = 4.16, Fe_2O_3 = 17.10, FeO = 3.52, MnO = 0.04, MgO = 5.19, CaO = 0.68, Na_2O = 0.26, P_2O_5 = 0.05, H_2O+ = 5.3, H_2O- = 25.4, total = 96.18% (3.82% siderite impurity). Assuming a smectite model with 44 negative charges per unit cell, the chemical composition gives a unit-cell formula with - 1.14 charges, corresponding to a cation-exchange capacity (CEC) of 135 meq/100 g. The same unit-cell charge is obtained when the structural formula is calculated on the basis of (Si + Al) = 8. The measured CEC of 60 meq/100 g indicates that the smectite structure may not apply to this hisingerite-material, and that in the alternative structure, all of the Al atoms may not be in the tetrahedral positions. Although the specific surface area of this material is between 662 and 758m^2/g (comparable to that of smectite), the infrared spectra do not show the characteristic OH vibrations, and the thermal analysis curves lack the dehydroxylation peak at 550 – 600 ° C expected for a smectite. Transmission electron microscopy shows indications of a layer structure and apparently hollow spherical bodies with ‘ onion ’ structure of 140 to 200 Å internal diameter, which might represent the sites of the large amounts of water contained by the material. The mode of occurrence and the nature of the hisingerite-material suggest precipitation from solution at relatively low temperatures.

Key Words: Electron diffraction • Hisingerite • Infrared spectroscopy • Iron • Saponite • Transmission electron microscopy

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