HISINGERITE AND IDDINGSITE ON MARS: Degradation of Iron-Rich Basalts.
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Iron-rich basalts, which erupted onto the surface of Mars from massive shield volcanoes such as Olympus Mons, have undergone extensive alteration to produce regolith dominated by Si, Fe, Al, Mg, Ca, S, and perhaps Na and H_2O or OH^-. The modal mineralogy of martian regolith is believed to be dominated by clay silicates, such as the smectites iron-rich montmorillonite or nontronite, coexisting with poorly crystalline and magnetic iron oxides, and Ca-Mg sulphates or hydroxo ferric sulfate minerals (e.g. jarosite) [1]. The phyllosilicate and ferric oxide phases were deduced to be poorly crystalline [2] in order to account for reflectance spectral profiles of Mars' surface in the visible-near infrared region [3]. Such phases also constitute iddingsite, a deuteric alteration product of olivine in basalts, which has been identified in meteorites believed to have originated from Mars. Paragenetic evidence summarized here indicates that hisingerite, too, may have formed during the evolution of martian regolith.

Numerous terrestrial occurrences of hisingerite, possessing vitreous luster, conchoidal fracture and pulverizing to orange-brown powder which resembles the color of martian regolith, have been documented [4]. Hisingerite is formed by deuteric and late-stage alteration of pyroxenes and olivine in mafic igneous rocks, particularly those associated with sulfide ore deposits [5,6]. Apparently, acidic solutions formed during the dissolution of sulfide mineralization has led to the formation of hisingerite in crusts, fracture fillings and cooling joints of iron-rich basaltic host-rocks. Similar environments of chemical weathering may also exist on Mars [1,7]. Hisingerite was once regarded as poorly crystalline iron-rich smectite or nontronite [4]. However, recent electron microscopy and X-ray studies [5,6] have revealed hisingerite to have an amorphous or gel structure containing a disordered array of $[FeO_6]$ octahedra and $[SiO_4]$ tetrahedra. It is just this coordination environment and degree of crystallinity that matches materials simulating the spectral properties of bright regions of Mars [5]. Therefore, hisingerite and basic ferric sulfate minerals (e.g. jarosite) appear to be major contributors to remote-sensed reflectance spectral profiles of Mars [8].

[1] Burns, *Nature*, **320**, 55 (1986); [2] Sherman *et al.*, *JGR*, **87**, 10169 (1982); [3] Singer, *Adv. Space Sci.*, **5**, 59 (1985); [4] Brigatti, *Proc. Int. Clay Conf., Bologna 1981*, 97-110 (1982); [5] Eggleton, *Clays & Clay Minerals*, **32**, 1 (1984); [6] Shayan, *Clays & Clay Minerals*, **32**, 272 (1984); [7] Burns, *JGR*, in press; [8] Research supported by NASA grant number NGR 7604.