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Disordered silica with tridymite-like structure in the Twiggs clay

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Abstract

The existence of a disordered silica polymorph dominated by tridymite-like stacking is implied by the long-held interpretation of opaline silica as disordered intergrowths of cristobalite-like and tridymite-like domains. The currently accepted model for diagenetic transformation of amorphous silica also predicts that early formed structures will be dominated by tridymite stacking. Although the cristobalitic end-member (opal-c) and intermediate structures (opal-ct) have long been acknowledged, the tridymitic end-member has not yet been recognized. Evidence for such an end-member is found in 54 Twiggs clay samples examined by X-ray diffraction (XRD). The mineralogy of the samples is dominated by smectite and disordered silica. The silica phase is biogenic in origin and presents an XRD signature consistent with that of line-broadened tridymite, with a broad primary reflection near 4.107 Å (21.6 °2θ), additional broad peaks of lower intensity at approximately 4.328 Å (20.5 °2θ) and 2.50 Å (35.9 °2θ), and lacking diagnostic cristobalite peaks at 3.14 Å (28.5 °2θ) and 2.84 Å (31.5 °2θ). At present, the most widely used classification of disordered silica is a threefold system that recognizes an amorphous phase (opal-a), a cristobalite-like end-member (opal-c), and intermediate structures incorporating both cristobalite and tridymite domains (opal-ct) (Jones and Segnit 1971). This classification does not accommodate a dominantly tridymite-like structure as is observed in the Twiggs clay. The silica phase in these samples is more accurately described as "disordered tridymite." A new term "opal-t" is proposed to describe this end-member phase.

Keyword: Opal, disordered silica, X-ray diffraction, cristobalite, tridymite, silica diagenesis