Silica in Soils: Quartz and Disordered Silica Polymorphs

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In nature, silica (SiO$_2$) occurs as seven distinct polymorphs: quartz, cristobalite, tridymite, coesite, stishovite, lechatelierite (silica glass), and opal; the latter two are amorphous. Of these minerals, quartz is most abundant in soil environments, while disordered cristobalite commonly occurs in soils. Tridymite is rare in soils and is usually associated with siliceous volcanic rocks. Coesite, stishovite, and lechatelierite are rare polymorphic forms produced at high pressures, but found under atmospheric temperature and pressure at sites of meteor impact. Opal is a hydrated “amorphous” silica that comprises the bulk of diatomaceous rocks of biogenic origin and silica of inorganic origin (Frondel, 1962; Deer et al., 1978).

This chapter emphasizes quartz and the disordered polymorphs of silica. The disordered polymorphs have been referred to by a number of conflicting and sometimes ambiguous names, often resulting in confusion. The definitions of the disordered silica polymorphs as proposed by J.B. Jones and Segnit (1971) appear to be more widely adopted and will be utilized, where possible, throughout this chapter. Each of these distinct and unique polymorphs of silica expresses a definite degree of structural order. The structural order defines the individual polymorph and results in unique physical and chemical properties which are briefly summarized below.

**Common Silica Polymorphs**

**Quartz.** This mineral is found in essentially all soils and parent materials. It often constitutes the major portion of all sand and silt fractions and is a major component of the coarse clay fraction of many soils.