Perry et al. (2006) contribute a fourth alternative, of silica binding, to three prior hypotheses of varnish formation: 1) abiotic Mn-Fe enhancement (e.g., Engel and Sharp, 1958); 2) biotic Mn-Fe enhancement (e.g., Dorn and Oberlander, 1982; Allen et al., 2004); and 3) a polygenetic clay-bacteria hypothesis (Dorn, 1998; Krinsley, 1998). Commentary by Berardelli (2006) also reveals that Perry et al. offer silica binding as a comprehensive model of how varnish forms.

A silica-binding model of varnish formation, however, is contradicted by prior literature in six independent ways. (1) A successful model of varnish formation must explain the tremendous enhancement of Mn in varnish (Engel and Sharp, 1958; Dorn and Oberlander, 1982; Potter and Rossman, 1979) but silica binding does not. Similarly, Mn-mineralogy of varnish (Potter, 1979; Potter and Rossman, 1979; McKeown and Post, 2001; Probst et al., 2002) is not explained by silica binding. (2) A successful model must explain the clear dominance of clay minerals in varnish (e.g., Potter and Rossman, 1977; Potter, 1979; Krinsley et al., 1995; Israel et al., 1997; Dorn, 1998 [Ch.10]; Krinsley, 1998; Probst et al., 2002; Allen et al., 2004) as opposed to the paucity of clay minerals in silica glaze (Curtiss et al., 1985; Dorn, 1998 [Ch. 13]), yet silica binding cannot. (3) A successful model must explain rock-coating geography. For example, one of Earth’s best Mars analogs exists on the Tibetan Plateau, where a study of varnish from the Ashiule Basin of the West Kunlun Mountains finds varnish resting adjacent to silica glaze at scales of microns to meters (Dorn, 1998, [Ch.15]). Silica binding fails to explain this common geographical juxtaposition. (4) The “baking” requirement runs contrary to varnish in subsurface and cold-climate settings (Douglas, 1987; Whalley et al., 1990; Dorn et al., 1992; Douglas et al., 1994). (5) Varnish microlamination analyses of over 10,000 sedimentary microbasins (Liu and Broecker, 2000; Liu et al., 2000; Broecker and Liu, 2001; Liu, 2003; Liu, 2006; Liu and Broecker, 2006), a method subjected to blind testing (Marston, 2003), represents the single largest varnish data set (Dorn, 2006). Yet, silica binding does not explain systematic differential Mn-Fe patterns that dominate varnish. (6) A successful model must explain rates of accretion ~1–10 µm per millennia (Dorn, 1998; Liu, 2006; Liu and Broecker, 2006), confirmed by further studies (Liu, 2003; Liu, 2006; Liu and Broecker, 2006). Whatever process creates varnish must have the extreme rate-limiting step that silica binding lacks. Silica glaze, in contrast, accretes in microns per decade (Curtiss et al., 1985; Gordon and Dorn, 2005).

The conclusion held by Perry et al. (2006) that silica glazes and varnishes are genetically linked appears to be contradicted by six independent criteria used in prior literature. Thus, silica binding is not important in forming the vast majority of varnishes. However, it is possible that silica binding could play a role in the genesis of a very specific type of varnish: ground-line bands found in warm deserts (cf. Engel and Sharp, 1958; Dorn, 1998 [Ch. 10]). This is the type of varnish that appears to be featured in post-pubication photographs and press releases (cf. Berardelli, 2006) about Perry et al. (2006).

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however, reveals that silicon is usually the predominant element in varnishes, and aluminum is sometimes the second most abundant. Aluminum quantities are highly variable and often not consistent with Al/Si ratios in clays. Clays are present in varnishes (Potter and Rossman, 1977), but we have only found minimal clay content in varnishes using particle size separations. The role of silica in desert varnish formation has been substantially neglected in previous research. We look forward to the contributions of others in furthering our understanding this enigmatic coating and elucidating its silica-based formation mechanism.

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