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Common gem opal: An investigation of micro- to nano-structure

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ABSTRACT

The microstructure of nearly 200 common gem opal-A and opal-CT samples from worldwide localities was investigated using scanning electron microscopy (SEM). These opals do not show play-of-color, but are valued in the gem market for their intrinsic body color. Common opal-AG and opal-CT are primarily built from nanograins that average ~25 nm in diameter. Only opal-AN has a texture similar to that of glass. In opal-AG, nanograins arrange into spheres that have successive concentric layers, or in some cases, radial structures. Common opal does not diffract light because its spheres exhibit a range of sizes, are imperfectly shaped, are too large or too small, or are not well ordered. Opal-AG spheres are typically cemented by non-ordered nanograins, which likely result from late stage fluid deposition. In opal-CT, nanograins have different degrees of ordering, ranging from none (aggregation of individual nanograins), to an intermediate stage in which they form tablets or platelets, to the formation of lepispheres. When the structure is built of lepispheres, they are generally cemented by non-ordered nanograins. The degree of nanograin ordering may depend on the growth or deposition rate imposed by the properties of the gel from which opal settles, presumably, fast for non-ordered nanograin structures in opal-CT to slow for the concentric arrangement of nanograins in the spheres of opal-AG.

Keywords: Opal-A, opal-CT, common opal, structure, SEM, nanograin