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Cinnabar Inclusions in Ethiopian Opal

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The authors recently examined a 15.8 ct Ethiopian opal (Figure 4) that contained numerous red dendritic particles that each measured up to 70-100 μm in diameter (Figure 5). The Ethiopian origin of the opal was confirmed by its physical properties (slight hydrophane character and rounded columnar structure) and its chemical composition (high Ba concentration; Rondeau *et al.* 2010). The inclusions were identified by Raman micro-spectroscopy as cinnabar (HgS). Energy-dispersive X-ray fluorescence (EDXRF) chemical analyses of the top surface of the sample confirmed the presence of Hg and S. Cinnabar and opal are associated in numerous localities, particularly in the western USA (Knopf 1915; Gettens *et al.* 1972; https://www.mindat.org/min-3004.html). However, cinnabar is only rarely mentioned as inclusions in opal (see, e.g., Gaillou 2015). Also known is an opalised or silicified cinnabar material known as myrickite, in which the high concentration of cinnabar inclusions induces an intense orange or red colour (Manutchehr-Danai 2009; Melero *et al.* 2019).

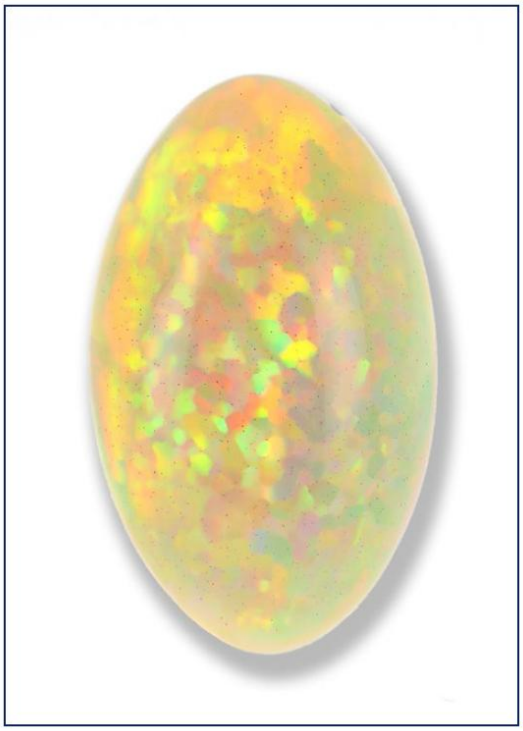

Figure 4: This 15.8 ct opal from Ethiopia was examined for this report. Photo by C. Caplan.

To the authors' knowledge, this is the first time that cinnabar inclusions have been documented in opal from Ethiopia. Their dendritic habit suggests relatively fast growth, whereas magnetite inclusions reported in Ethiopian opal have a well-formed octahedral habit (Rondeau *et al.* 2010), suggesting slow growth. This points to a vast domain of parameters possible (at least in terms of growth rate and chemistry) for the formation of

inclusions in Ethiopian opal, which perhaps reflects the expansive region over which those deposits occur.

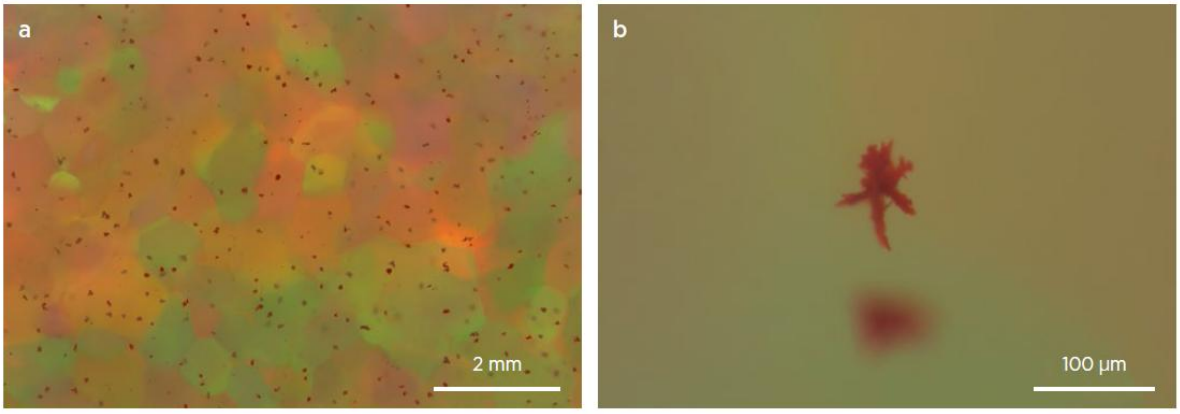

Figure 5: (**a**) The opal contains red cinnabar inclusions across the top surface of the cabochon. (**b**) A closer look at one of these inclusions shows its dendritic form. Photomicrographs by F. Notari.

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