**SIGNIFICANCE OF OPAL IN UREILITES – DELIVERY OF $H_2O$ TO THE INNER SOLAR SYSTEM?**

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**Introduction:** Numerous fragments of opal ($SiO_2.nH_2O$) have previously been reported in 5 internal chips of polymict ureilite EET83309 [1]. The largest fragments are >300μm in the longest dimension and show clear banding. The bands are terminated by the adjacent olivine clasts, indicating that the opal clasts were not formed *in situ*. Opal is also found in contact with ureilitic olivine, forming a single clast with a terrestrial weathering rim around both minerals. It also occurs as thin (10μm) rims completely surrounding suessite ($Fe_3Si$) grains, and can also contain inclusions of schreibersite. It shows no relationship whatsoever with terrestrial weathering rims. These petrographic observations indicate that the opal is (a) extraterrestrial in origin, and (b) native to the ureilite parent body. Suessite and schreibersite are considered to be the products of reduction during shock metamorphism. Therefore formation of the opal occurred after the formation of suessite but before the formation of the regolith represented by polymict ureilites.

**Opal composition**: Opal is hydrated silica containing 10-30 wt% $H_2O$. XRD analysis suggests that the opal in EET83309 is of the amorphous opal-A variety, although it appears to have undergone some recrystallization to a $SiO_2$ phase. The largest opal clast has a composition of approximately 65.5 wt.% $SiO_2$, 6 wt.% FeO and <1wt.% MgO. In contrast, terrestrial opals only contain up to 1.0 wt% FeO and 0.06 wt. % MgO [2]. The origin of the water or ice which reacted with Si-rich minerals to form the opal is unknown but must be extra-terrestrial in origin, possibly due to impact of an icy body such as a comet on the surface of the ureilite parent body.

The identification of hydrated silica (opal) by the Mars Exploration Rover (MER) Spirit in the Gusev Crater, Mars [3] and presence of opal in ureilite EET83309 has implications for the presence of water and its delivery by cometary bodies during the early formation of the Inner Solar System.

**References:** [1] Beard A. D. et al. Abstract # 5027, 72nd Annual Meteoritic Society Meeting. [2] Gaillou E., et al., 2008. Ore Geology Reviews, 34. 113-126. [3] Rice et al., Icarus, 205, 375-395.