FLUID INCLUSIONS IN CHONDRITES

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Introduction: We report progress in our search for aqueous fluid inclusions from within chondrites, building on our discovery of them within halite and sylvite crystals in the Monahans (1998) and Zag H5 regolith breccias [2].

How to search for fluid inclusions: Given that many extraterrestrial materials have experienced extensive aqueous alteration, why have aqueous fluid inclusions not been reliably reported there before? Here is why: (1) Practically all samples are prepared using water, with obvious results. (2) Most thin sections are heated during preparation, resulting in the decrepitation (destruction) of most fluid inclusions. (3) Practically all prepared samples are studied using electron- or ion-beam instruments, resulting in further heating and inclusion homogenization and/or decrepitation. (4) Most fluid inclusions are very small, and single phase (fluid only), rendering them almost indistinguishable from other growth defects.

Here are the procedures we have learned to take: (1) Use the freshest, least terrestrially-altered specimens available. (2) Prepare all thin sections using alcohol as the only fluid, and grind and polish very slowly to inhibit heating. (3) Examine separated grains rather than thin sections whenever possible. (4) Freeze all samples before examination, to promote nucleation of vapor bubbles in otherwise single-phase inclusions, so that fluid inclusions can be more easily identified.

Potential fluid inclusions: In the past we have been locating potential fluid inclusions in CM chondrite olivine and carbonates. We have lately been concentrating on carbonates in the CI chondrites Orgueil and Ivuna, using standard petrographic and computerized X-ray microtomographic techniques (X-ray CT). Orgueil carbonates contain few if any fluid inclusions, all of which are very tiny (~1-5 microns at most), while Ivuna Ca-Mg carbonates frequently contain them. The potential fluid inclusions in Ivuna are commonly under 2 micrometers in diameter, but range up to many 10's of microns in places. It is possible that Orgueil has experienced too severe brecciation [2] to have preserved fluid inclusions in such unresilient minerals as carbonates. To test this we are doing X-ray CT imaging of Orgueil sulfide crystals. We are now examining all potential fluid inclusions by Raman microspectrometry.

References: [1] Zolensky et al. (1999) *Science* **285**, 1377. [2] Endreß and Bischoff (1993) *Meteoritics* **28**, 345.