Meteorite Sample Section Repair at NASA Johnson Space Center. R. Harrington[1] and K. Righter[2], [1]Jacobs/JETS, 2101 NASA Pkwy, Houston, TX 77058, [2]ARES/NASA Johnson Space Center, 2101 NASA Pkwy, Houston, TX 77058.

Introduction: Meteorite thin and thick sections are routinely shipped from NASA Johnson Space Center to fulfill sample allocation requests from principle investigators around the world. Sections are also returned to JSC when researchers are finished studying them since, in most cases, they can be reused for other studies. The sections are very fragile unfortunately, and sometimes return to us needing repairs. The following should give you an idea of how we repair sections here in the very lab where they were created. NOTE: Please do not attempt to repair ANSMET meteorite sections that are in your possession. We will perform the repairs for you at NASA JSC if you send the section back to us.

Section Delamination: The majority of the meteorite sections that we produce here are secured to the glass slide using a high quality, two-part epoxy. Occasionally, we are asked to use superglue if the researcher wishes to dismount the section from the slide. Both epoxy and superglue are excellent adhesives, but they both tend to embrittle with time which results in delamination from the slide. Exposure to vacuum can also degrade the adhesion between the sample section and the glass slide. Repeated handling of the slide edges can accelerate delamination and, as a preventive measure, the outer 1-2 mm of epoxy is trimmed from newly created sections at JSC. If conductive tapes (copper, carbon, etc.) are used on the section during analysis, great care must be taken in removing the tape so that the epoxy is not pulled up with it. If in doubt, the tape can be left on the section when it is returned to JSC.

Fig. 1 – Successful delamination repair. *(NASA JSC)*

Before we perform any repairs to sample sections, carbon, gold, or other coatings are removed. We accomplish this using a slurry of 0.05 micron alumina and 190 proof ethyl alcohol applied to a felt polishing pad fitted to a rotating lap wheel. Coatings are removed in this manner from all sections that are returned to JSC.

The extent of the delamination determines how we proceed with the section repair. If the meteorite sample area of the section is not disturbed, then we carefully remove the delaminated epoxy. This is done using a binocular microscope with a 6X zoom, cut-proof gloves, and a very sharp, single edged razor blade. We cut the delaminated epoxy with the blade angled away from the sample area and using very light pressure. The trimmed section is then cleaned in an ultrasonic bath of 200 proof ethyl alcohol for no more than 10 seconds and carefully dried using a lint-free cleanroom wipe. The section is then placed into a lab oven at 110° F in preparation for epoxy.

We mix the resin and hardener components of the low viscosity epoxy and very small amounts are applied to the cut edges of the section using a needle probe and the binocular microscope. Warming the epoxy helps secure the existing section by filling any voids between the glass slide and the section. After the new epoxy cures, we give the section a light polish on a lap wheel fitted with cotton polishing paper that is charged with 1 micron diamond paste.

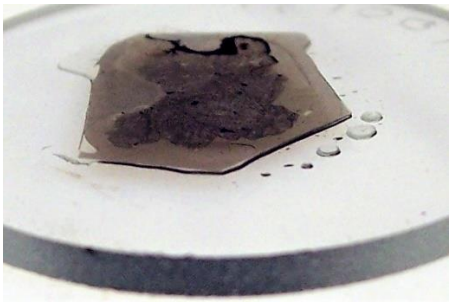

Fig. 2 – Failed delamination repair. The sample area is rippled and the epoxy edge is curling upwards. *(NASA JSC)*

If the section has delaminated to the point of sample area being lifted from the glass, then it may be irreparable. We employ the above technique along with clamping the section in a Teflon pad arrangement in order to flatten the sample while the epoxy cures. Otherwise, the sample will tend to curl. This works to some degree, but once the sample area curls, it seldom returns to the original flatness without cracking or bending.

Canada Balsam and Crystalbond: We repair damaged sections that had originally been prepared using

Canada Balsam or Crystalbond adhesives through the gradual application of heat. We take great care with these samples since these bonding materials tend to get brittle with age. The section is heated in gradual steps (40-50º F per hour) to the melting point of the adhesive. We repair the sample while the adhesive is fluid and then the section is cooled in the same gradual manner in which it was heated.

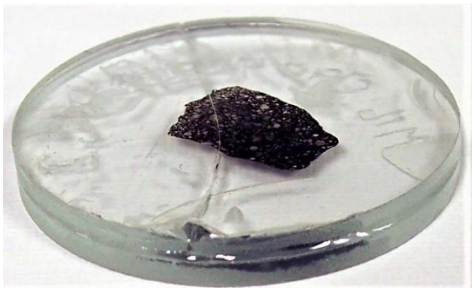

Fig.3 – Backer slide repair. (*NASA JSC)*

Slide Cracks and Breaks: Accidents happen. Especially with something as small and fragile as a thin/thick section. We all know someone who has driven a microscope objective into a section. As bad as the damage may look, the section can be repaired in most instances. NOTE: Please do not try to tape or glue section pieces back together prior to returning the damaged section. This practice usually renders the section irreparable.

If the glass slide is cracked but the section is still in one piece, we repair it by infilling the crack with the low viscosity epoxy mentioned earlier. If the slide is in pieces, we can reassemble it with epoxy on a new backer slide. This is a tricky task as the pieces need to be in the correct plane with respect to each other, especially if the sample area is split among several pieces.