The Kaidun meteorite: Melt deposits on the surface of some particles.
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Summary. Three complex areas of melt deposits ("splashes") were found on particles of the Kaidun meteorite. The compositions of the splashes indicate that they consist of impact-generated metal material modified by aqueous alteration. The splashes present in Kaidun provide information regarding the asteroidal regolith sampled by this unique meteorite.

Splashes are very common features on the surface of lunar regolith particles [1, 3]. The splashes form by micrometeorite bombardment of the lunar surface, which is one of the main processes of regolith formation on atmosphereless bodies. We report here the discovery of splashes on the surface and inside of small fragments of the Kaidun heterogeneous meteorite breccia.

An open cavity with a glassy coating on one inner wall was found on sample #53.02. The polished section of the fragment (Fig.1) shows a lithological difference between two walls of the cavity; the coated wall has an olivine composition while the opposite wall is a breccia of a carbonaceous chondrite material. The thickness of the coating is up to ~100 micrometers. The contact of the coating with the olivine clast (Fig.2) is complex. The contact of the coating with a carbonaceous material is sharp by comparison. The coating's composition is essentially iron oxide with rather small admixture of lithophile components (see table).

A similar feature was found in Kaidun thin section #58.02 (Fig.3). Inside this sample there is an elongate cavity; two walls of the cavity consist of carbonaceous chondrite material of two different lithologies, and one of the walls has a coating with thickness up to 15 micrometers. The composition of this coating (see table) is similar to the composition of the coating in #53.02.

The characteristics of the coatings in #53.02 and #58.02 are summarized as: (1) presence in cavities on one of the walls, (2) different lithologies of the coated and non-coated walls, (3) the traces of a complex interaction between coating and wall in #53.02. These characteristics suggest that the coatings were applied to regolith grains before the consolidation of the samples studied. The present composition of the splashes can be interpreted to result from aqueous alteration of metal.

A surface detail with morphology that is identical to lunar splashes was found on the sample #53.15 (Fig.4). The size of the splash is ~0.6 mm. The smallest details of the relief of the target are seen on the splash revealing its very small thickness. The character of interaction of splash material with a small hillock on the surface of the target shows the direction of movement of melted material during splash formation (arrow on Fig.4). There are small fractures on the splash that resemble shrinkage cracks. We could not analyze quantitatively the material of the splash, however it was clear that the material is very iron-rich. It is also possible that this splash is altered metal.

A study of the process of aqueous alteration of metal grains showed [3] that the compositions of the products of aqueous alteration of metal vary considerably depending upon precursor rock mineralogy, fluid composition and alteration conditions. We were not able to identify the possible primary metal composition or to determine whether all splashes studied were result of the same micrometeorite collision.
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The morphological evidences of regolith processes are very rare in meteorite. The presence of splashes in Kaidun could provide an important glimpse into the regolith stage of this unusual meteorite.

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Table. Chemical composition of the splash materials.

<table>
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<th></th>
<th>SiO₂</th>
<th>Al₂O₃</th>
<th>Cr₂O₃</th>
<th>FeO</th>
<th>MnO</th>
<th>MgO</th>
<th>CaO</th>
<th>Na₂O</th>
<th>P₂O₅</th>
<th>NiO</th>
<th>CoO</th>
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<td>0.33</td>
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<td>0.51</td>
<td>0.60</td>
<td>0.43</td>
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<td>2.86</td>
<td>-</td>
<td>0.30</td>
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<td>0.22</td>
<td>0.21</td>
<td>61.81</td>
<td>0.41</td>
<td>1.77</td>
<td>0.22</td>
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<td>9.82</td>
<td>1.88</td>
<td>1.25</td>
<td>86.40</td>
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</tbody>
</table>

Fig.1. Glassy coating on the wall of the cavity in #53.02. Scale bar 1 mm.
Fig.2. A detail of Fig.1. The different character of the contacts of the coating with the olivine clast (left) and carbonaceous matrix is seen. Scale bar 10 μm.
Fig.3. Glassy coating on the wall of the cavity in #58.02. Scale bar 10 μm.
Fig.4. Splash on the surface of #53.15. The arrow shows the direction of motion of melted material. Scale bar 300 μm.