

14310

Crystalline sample 14310 was collected during the second EVA at station G. The collection was not well documented -- no lunar-surface photographs were made, and the orientation is known only from surface pitting.

PHYSICAL CHARACTERISTICS

Mass

3439.0 g

Dimensions

19 x 14 x 11 cm

This rock is a medium, gray, blocky melt rock, which is subrounded on the pitted sides. It is fine grained and homogeneous in mineralogy.

SURFACE FEATURES

This rock has a smooth surface and is densely pitted on the two sub-rounded faces. The other three faces are angular and show no evidence of previous microcrater bombardment. The zap pits range in size from 0.1 mm to 4.0 mm, with approximately 90% of them glass-lined. There are estimated to be 20-50 pits per square centimeter on the pitted faces. There are two exfoliation fractures, one of which is parallel to the fresh surface. There are feldspar-lined vugs 0.5 - 2 mm in diameter covering 1% of the surface of 14310. In large cavities, the feldspar appears to have a honeycomb texture, but in smaller cavities there are clear to gray feldspar crystals projecting into the vugs.

PETROGRAPHIC DESCRIPTION

The rock is composed of feldspar and pyroxene in approximately equal quantities. The feldspar occurs as both clear and turbid euhedral grains of 0.3 mm size. Pyroxene occurs as turbid subhedral grains 0.2 - 0.3 mm in size. Traces of opaques with grains < 0.1 mm are also present. The rock is medium grained and very homogeneous in texture.

In thin section (14310,5), the rock is seen to be composed of 31% pyroxene (mostly pigeonite), 68% plagioclase (~An₉₀), 0.5% opaques (ilmenite, chromite, ulvospinel, and troilite), and a trace of metal, with only 0.5% mesostasis. Reid and Melson (LSPET 1971) describe thin sections 14310,4; 14310,5; 14310,6; as having intersertal to subophitic texture. Platy plagioclase forms a framework, with individual crystals as long as 1 mm, and length/width of approximately 30. Pigeonite, possibly rimmed in places by augite, occurs in interstitial to subophitic to sheaf like grains. Discrete areas (as large as 500 µm across) consist of a felted aggregate of plagioclase (and minor alkali feldspar?) laths with a grain size noticeably smaller than the rest of the section. What can be described as a "cognate xenolith" consists of an area 3.3 x 1.5 mm, with the same phases as the remainder of the section, but with a noticeably finer grain size. It is this sort of area that suggests that basalt samples such as 14276 and 14310, for example, were melted during impact, rather than formed by the usual igneous processes. This is especially evident in thin section 14310,564 which contains a breccia clast enclosed by crystalline material.

The mesostasis includes late stage, very diverse materials. Some can be resolved into colorless material (glass?) with opaque to reddish brown spherules, and high relief fibers (apatite?). Minerals include ilmenite, metal (some as spherical droplets), "apatite" (as high relief, low birefringent needles), and an orange-brown mineral (as minute isotropic grains with high reflectivity and relief, platy habit, and pseudo-hexagonal outline, possibly hercynite).

DISCUSSION

Originally believed to be a "type sample" of KREEP basalt, sample 14310 received a great deal of attention (Brown and Peckett, 1971; Gancarz et al., 1971, 1972; Ridley et al., 1972; Longhi et al., 1972; Hollister, 1972; and others). However, it has become apparent that 14310 should not be considered the "type sample" KREEP (Meyer, 1977). The composition of 14310 is like that of soil sample 14163 and it contains a high proportion of siderophile elements as well as included Fe-Ni-P-S melt globules (El Goresy et al., 1972; James, 1973) and therefore appears to have been formed as an impact melt rock. The texture of 14310 ranges from fine-grained subophitic to fine-grained intergranular. Gancarz et al. (1971) present a large color photo-micrograph of the texture. Plagioclase forms an interlocking network of randomly oriented laths (~ 200 μm). Phenocrysts of plagioclase (2 mm) also form part of this network. Pyroxene occurs as intergranular to subophitic grains in the interstices of this plagioclase network. The cores of the pyroxene are orthopyroxene which zone to pigeonite. Augite sometimes forms epitaxial overgrowths on the pigeonite. Ilmenite occurs in the interstices and is intergrown with the outer margin of pyroxene grains. The mesostasis contains globules of Fe-Ni metal -- schreibersite-troilite, Ba-K feldspar, baddeleyite, tranquillityite, Ca-phosphates and patches of above mentioned silica-rich glass. However, in 14310 this glass is often devitrified.

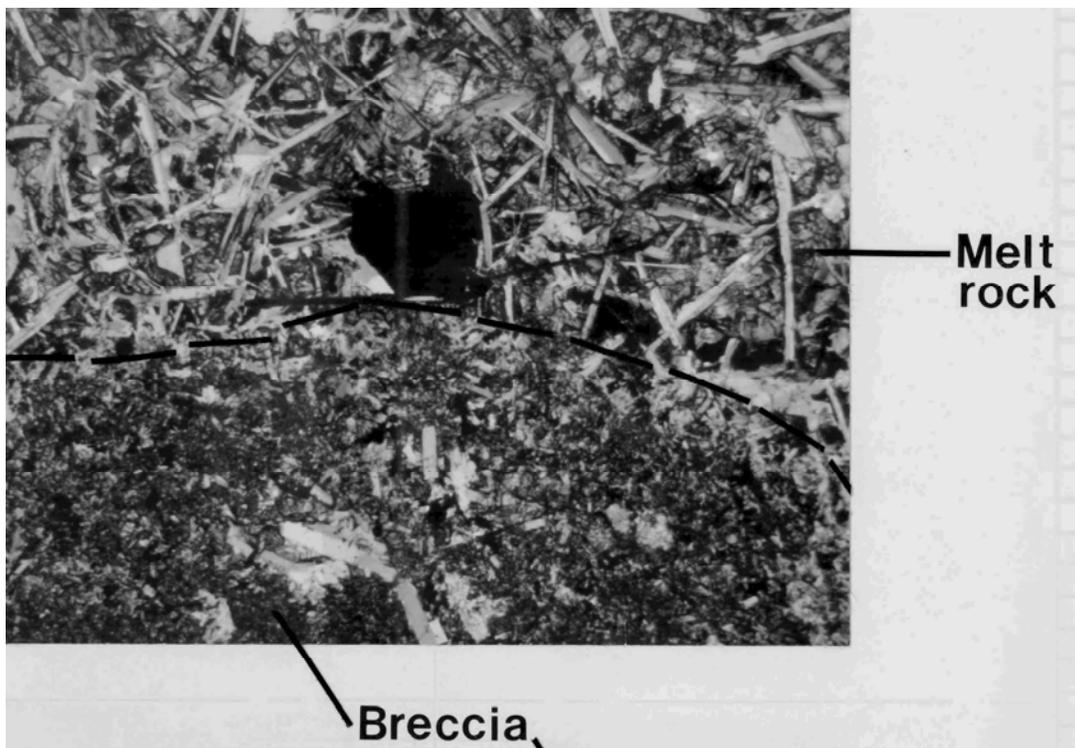
Observation of a large number of thin sections (~30) of 14310 shows that there may be a range in the mineralogical mode (Ridley et al., 1972). Such modal variations as well as a rather wide range in the chemical analyses confirm that 14310 is not a homogeneous rock. In addition, James (1973) and LSPET (1971) report apparently cognate inclusions which are present as small clasts (2 mm across) made up of tightly intergrown plagioclase laths, as well as patches of silicate intergrowths which have significantly coarser grain size than the rest of the rock.

In a thin section study of 14310, Brown and Peckett (1971) found that plagioclase phenocrysts were strongly zoned to more sodic and potassic compositions in their outer margins whereas the groundmass plagioclase laths were as calcic as the phenocryst cores. In view of these data they proposed that the basaltic lava lost Na and K by volatilization from the lunar surface during its crystallization. However, Ridley et al. (1972) & Longhi et al. (1972) observe that plagioclase laths often intrude and are included within phenocryst rims and that there is actually a considerable range in the composition of the laths. They conclude, instead, that the alkali content varied locally within the plagioclase network and that some phenocryst rims actually grew later than many of the laths. However, the presence of volatiles in the melt and escape of volatiles during crystallization is attested to by the presence of vugs in the rock. The composition of this volatile phase is still unknown.

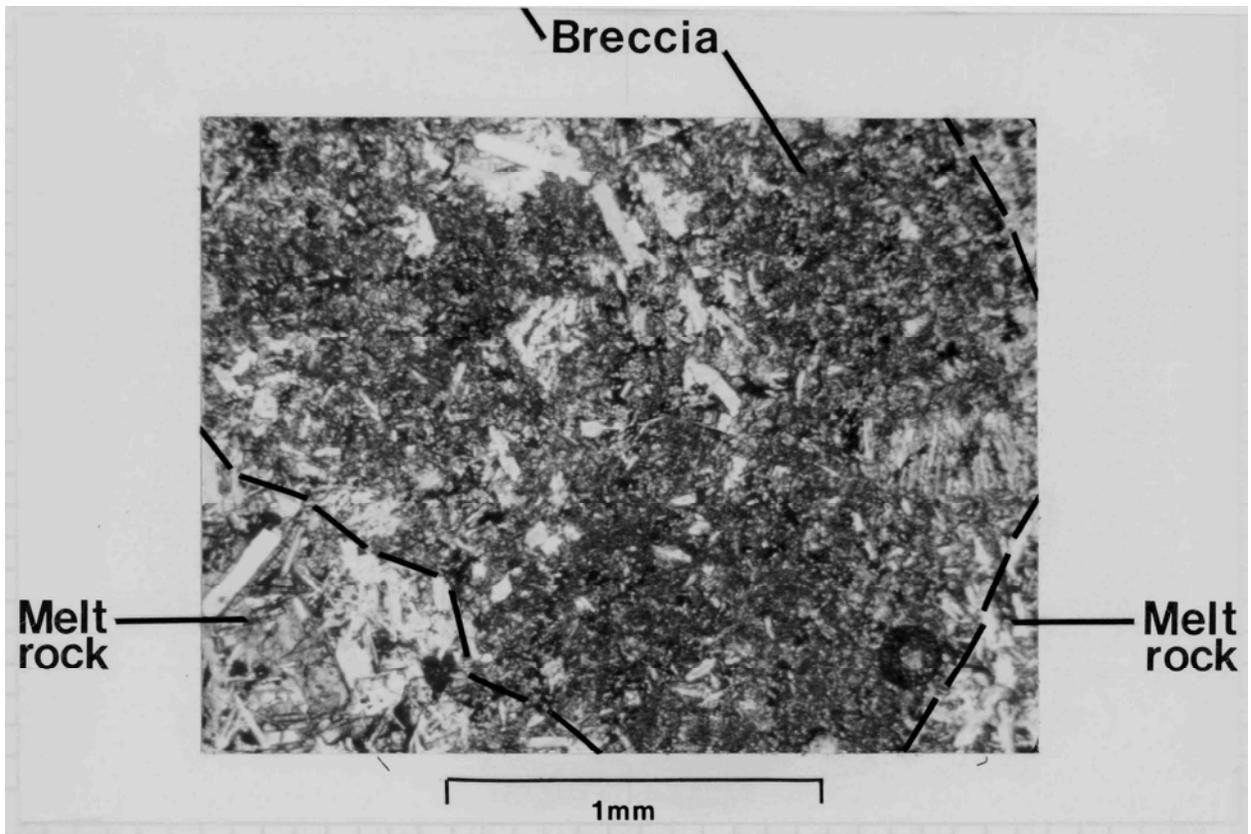
Sample 14310 is listed as a basalt by Wilshire and Jackson (1972) and as a clast-free impact melt rock by Simonds et al. (1977). Wasserburg and Papanastassiou (1971) describe it as closely resembling sample 14276 and different from mare basalts. Ages cluster at 3.88 ± 0.04 billion years ago on these samples, distinct from the age of 3.95 ± 0.03 billion years before present, obtained on 14053 and a clast from 14321 (Papanastassiou and Wasserburg, 1971).



S-71-30340



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