15075 PORPHYRITIC SUBOPHITIC QUARTZ-NORMATIVE MARE BASALT ST. 1 809.3 g

INTRODUCTION: 15075 is among the coarsest-grained quartz-normative basalts, and contains pigeonite phenocrysts. It has been dated as ~3.4 b.y. old. The sample (Fig. 1) is blocky, rounded, tough, and a light olive gray. It had a small fillet when collected, and it has a few zap pits on some surfaces.

15075 was collected on the east flank of Elbow Crater, as one of 5 basalt samples collected on a line extending out from the crater (see Fig. 15065-1). 15075 was collected, with 15076 and soil samples, about 25m east of the Elbow Crater rim crest, as one of a cluster of rocks, all of which had the same surface texture and albedo. The orientation of 15075 is known.

Figure 1. Macroscopic view of 15075. S-71-43852

PETROLOGY: 15075 is a coarse, quartz-normative basalt lacking magnesian olivine (Fig. 2). A detailed description was given by Taylor and Misra (1975) who described the texture, reported mineral analyses, and interpreted the paragenesis and cooling rate. The most striking feature is the presence of pyroxene phenocrysts up to 6 mm long and invariably zoned. The interstitial regions are dominated by lathy to tabular plagioclases (up to 2 mm long) and anhedral to subhedral pyroxenes. Pyroxenes and plagioclase compose 90% of the rock; accessories include pyroxferroite, cristobalite, tridymite, ilmenite, spinels, baddelyite, troilite, Fe-Ni metal, and fayalite.

Figure 2. Photomicrographs of 15075,45. Same field, same scale;
(a) transmitted light; (b) crossed polarizers.

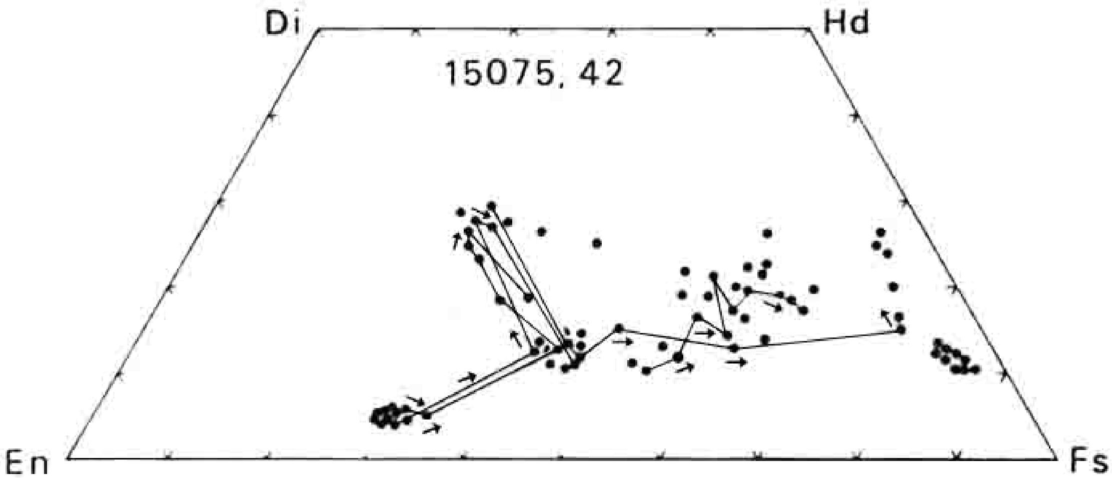

Figure 3. Pyroxene compositions
(Taylor and Misra, 1975).

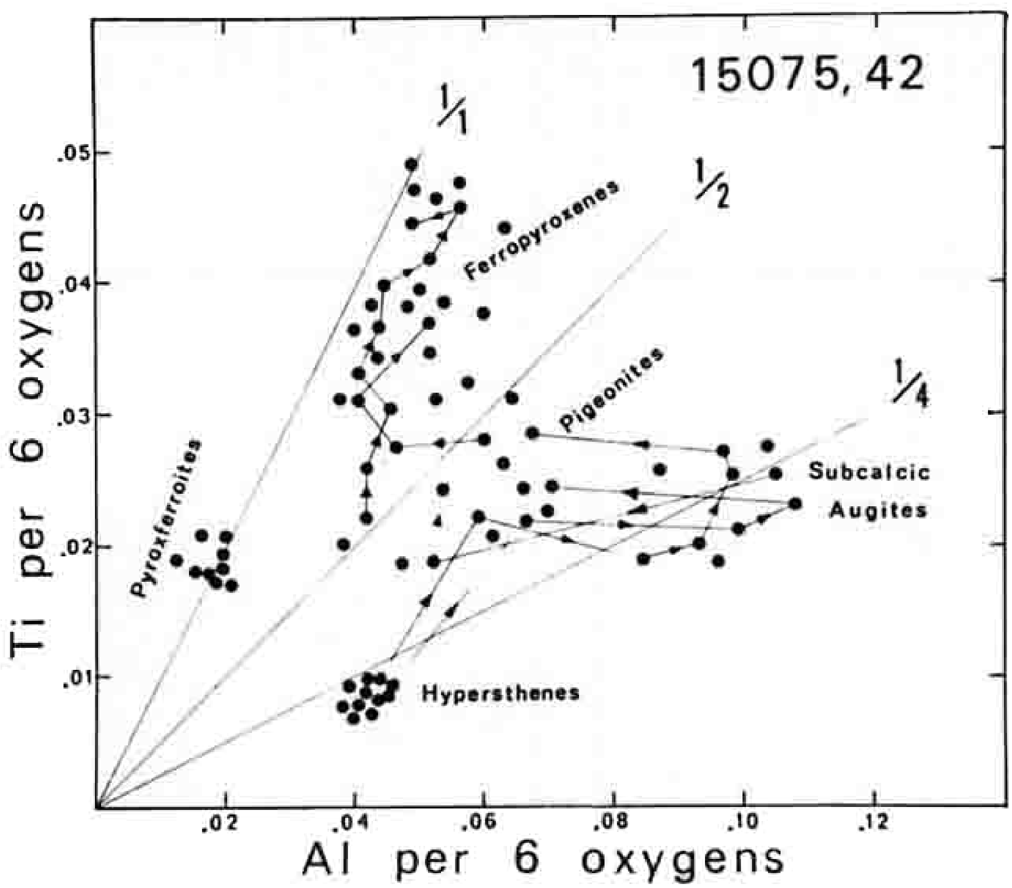

Figure 4. Ti/Al of pyroxenes
(Taylor and Misra, 1975).

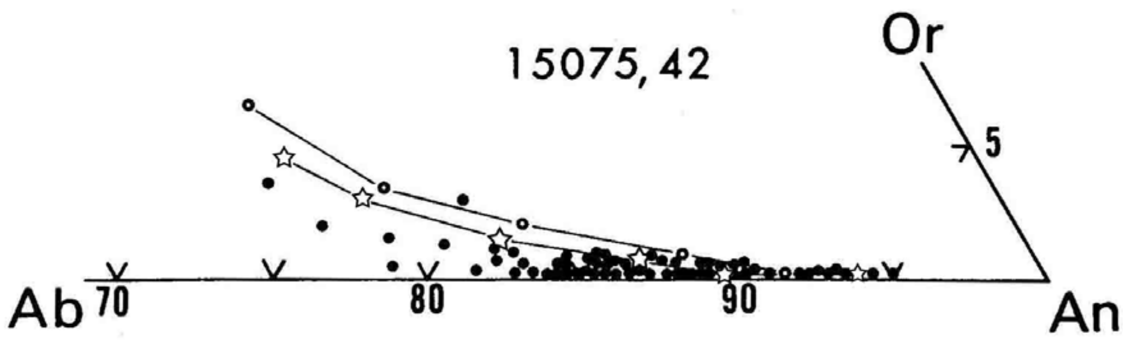

Figure 5. Plagioclase compositions
(Taylor and Misra, 1975)

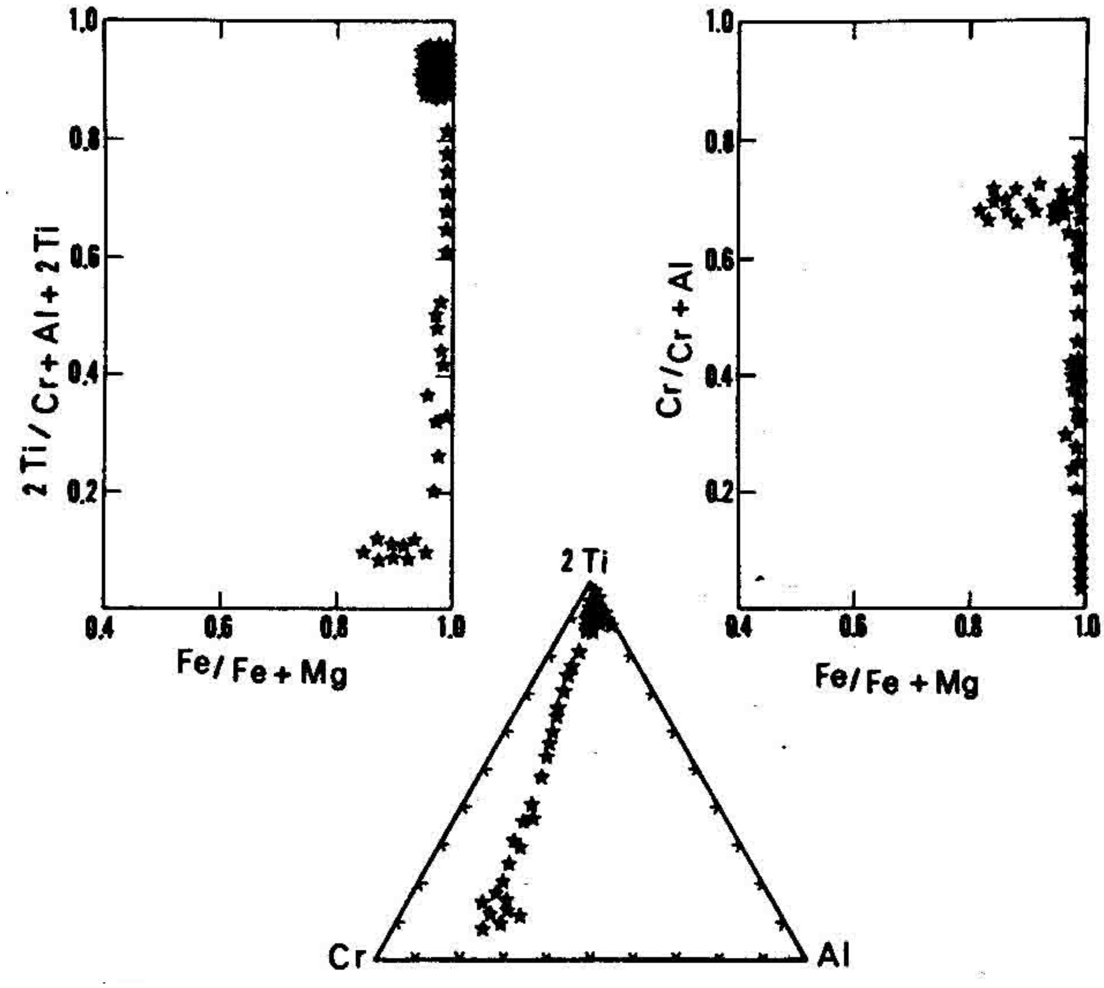

Figure 6. Spinel compositions
(Taylor and Misra, 1975).

Pyroxenes show spectacular zoning (Figs. 3, 4) from "hypersthene" and pigeonite cores outwards, with a sharp discontinuity with the appearance of subcalcic augite, marking the beginning of plagioclase crystallization. Pyroxferroite constitutes 2 to 5% of the sample, as late-stage material, usually with cristobalite. Many have broken down to a fayalite + Ca-rich pyroxene + silica intergrowth, but others persist metastably. Plagioclases are zoned normally, from An_{90-95} cores to An_{70-80} rims (Fig. 5). Iron increases as plagioclase becomes more calcic. Cristobalites and tridymite constitute 3-5% of the sample, cristobalite as fairly large subhedral grains in the groundmass, tridymite typically as bladed crystals, spinels of the chromite-ulvospinel are common. Ilmenites typically occur near the center portions of ulvospinel grains and have low MgO (<0.3%). The few Fe-Ni metal grains occur mainly as inclusions in pyroxene cores, less commonly in subcalcic augite, and rarely in ferropyroxenes. They are rounded in form and contain more than 1% cobalt (Fig. 7). Troilite is rare.

According to Taylor and Misra (1975) the liquidus phases were chromite, Fe-metal, and low-Ca pyroxene. Plagioclase started crystallizing very late; olivine was also very late, crystallizing only as fayalite. Metal and spinel apparently crystallized throughout the cooling of the rock. Subsolidus reduction of late-stage phases (pyroxferroite, ulvospinel) and reactions to form fayalite rims probably took place in the subsolidus.

Simmons et al. (1975) studied microcracks with optical and SEM methods, identifying shock-induced cracks and showing the curved cracks across the cleavage which are characteristic of the cores of pigeonites. The sample is highly cracked. The rock was subjected to "differential strain analysis," and Simmons et al. (1975) plotted differential strain v. pressure, and crack closure pressure distributions. The crack spectra, like other lunar samples, are quite different from terrestrial samples, probably because of shock effects on lunar samples.

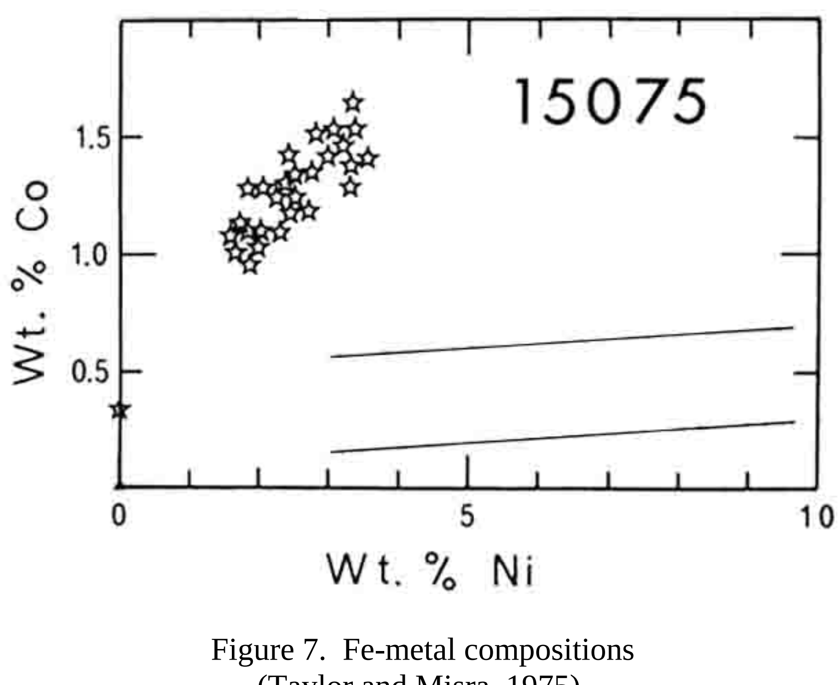

Figure 7. Fe-metal compositions
(Taylor and Misra, 1975).

Cooling Rates: Taylor and Misra (1975) attributed the porphyritic texture to a one-stage cooling history, as concluded by Lofgren et al. (1975) on the basis of linear cooling rate studies (but see also Grove and Walker, 1977, even though they did not specifically discuss 15075). They deduced an equilibration temperature of 918°C for the partitioning of Zr between ilmenite and ulvospinel, calculating from that a cooling rate of 3°C/day (also Taylor et al. 1975). Lofgren et al. (1975) concluded that the cooling rates were less than 1°C/day, on the basis of phenocryst shapes and matrix textures, thus 15075 is one of the slowest-cooled of the quartz-normative basalts. Onorato et al. (1979) refined the Zr partitioning model and calculated cooling rates of 0.2°C to l°2°C/day.

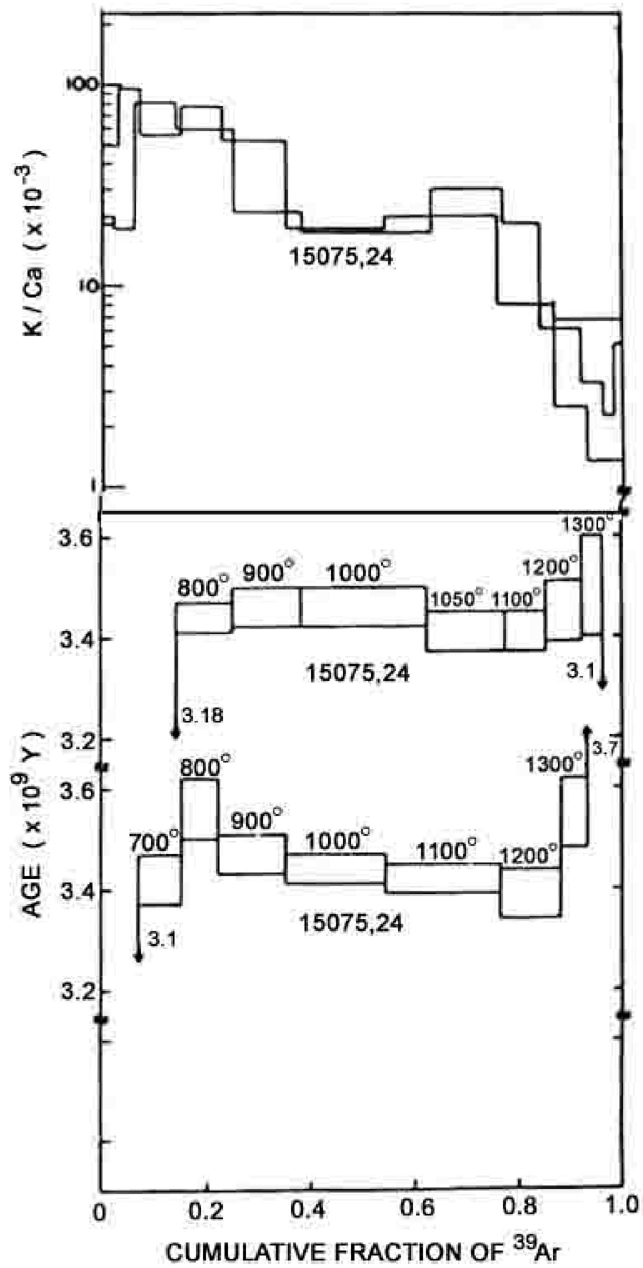

Figure 8. Ar release diagram (Schaeffer and Schaeffer, 1977).

CHEMISTRY: Little chemical data has been published. Cripe and Moore (1975) measured 390 ppm S. Schaeffer and Schaeffer (1977) in their Ar-Ar geochronology for two splits found 16.8 and 16.0% CaO (which seem very high) and 0.0370 and 0.0513% K_2O. These data alone are insufficient to classify the basalt.

GEOCHRONOLOGY AND EXPOSURE: Schaeffer and Schaeffer (1977) analyzed two splits with the Ar-Ar method, finding plateaus in the 800° to 1300°C release (Fig. 8) which correspond to ages of 3.45 ± 0.20. This age is among the oldest of Apollo 15 mare basalts. There is some gas loss in the less than 800°C fraction, and K/Ca decreases continuously over the entire analysis. Both splits give total K-Ar ages of 3.39 b.y. Exposure ages (^{38}Ar method) of 274 and 258 m.y. were determined from the plateau range gas releases.

PROCESSING AND SUBDIVISIONS: Initially, a small piece (,1) was chipped from the sample to make thin section ,4. Subsequently the sample was substantially sawn (Fig. 9) for allocations. End piece ,5 (171.5 g) is in remote storage; end piece ,25 has a mass of 382.6 grams. Slab piece ,15 was made into a potted butt for thin sections ,40 to ,46.

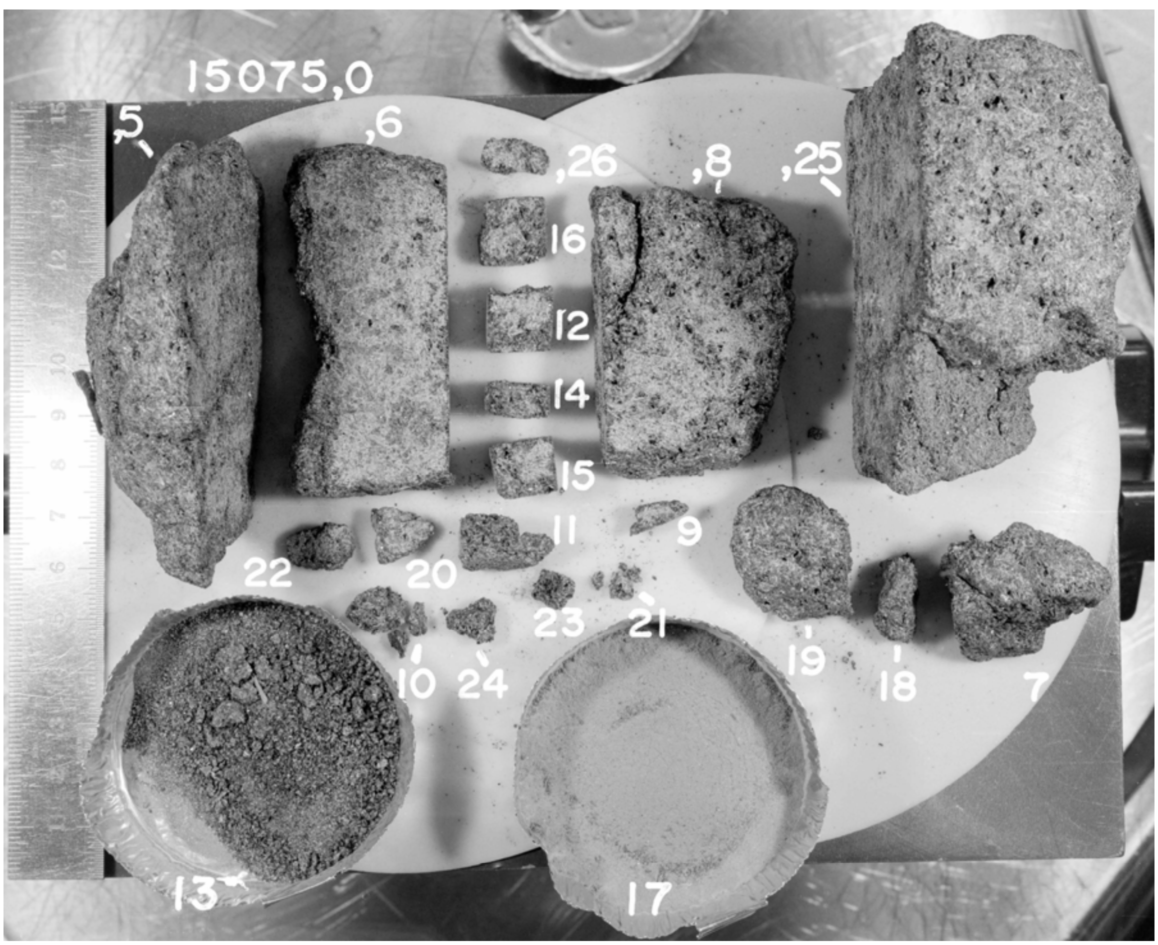

Figure 9. Slabbing of 15075. S-74-31232