JOURNEY TO THE CENTER OF THE REGOLITH: PETROLOGY AND MINERAL CHEMISTRY OF A NEW FERROAN ANORTHOSITE FROM DRIVE TUBE 68002/68001

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We report the first petrographic and mineral-chemical analyses of rock fragments from double drive tube 68002/68001. Two clasts were allocated; one is a basaltic impact melt with acicular, calcic plagioclase (An_{86-93}), microphenocrysts in a devitrified glass matrix. The other fragment is a granular ferroan anorthosite (An_{92-94}) with orthopyroxene compositions of En_{52-58}.

INTRODUCTION -- Double drive tube 68002/68001 was collected near South Ray crater, along the rim of Wreck crater, by Apollo 16 lunar module pilot Charles M. Duke, Jr. [1]. Over twenty years later, sample 68002 (the upper part of the core) was extruded from the drive tube on February 17, 1993 and several dissection passes were made by the Curatorial Staff at Johnson Space Center, Houston. A large anorthositic fragment was discovered in the second pass from 0.4-3.7 cm from the lunar surface, and a smaller, basaltic fragment was found 4.5 to 5.0 cm from the lunar surface. Probe mounts were made and allocated of both fragments ("anorthosite" = 68002,2131; "basalt" = 68002,229) and a 215 mg sample of the "anorthosite" (68002,2128) was allocated at the same time. INAA analyses (for siderophiles) will be performed on this "anorthosite" sample to determine its chemical pristinity.

PETROLOGY AND MINERAL CHEMISTRY -- Sample ***68002,229*** is an oval-shaped fragment approximately 2 mm across and consists of devitrified glass and fine skeletal grains hosting acicular, plagioclase microphenocrysts (< 1mm in longest dimension; Figure 1: field of view is 2 mm across). The plagioclase microphenocrysts comprise approximately 30% of the fragment and vary in composition from $An_{93.7}$ to $An_{95.3}$ although rims of more equant grains can have compositions as low as An_{85}. Olivine is rare and equant and has a composition of Fo_{78}. FeNi metal is present and contains Ni and Co abundances of 5 to 7 wt.% and 0.5 to 0.6 wt.%, respectively. The texture, mineralogy, and mineral chemistry of sample ***68002,229*** lead to the preliminary conclusion that it is an **impact melt**.

Figure 1

Sample ***68002,2128*** is an equigranular, hypidiomorphic, granulated fragment measuring 7 mm in longest dimension (Fig. 2: next page; field of view is 2.5 mm across); the parent sample (68002,2117) was much larger, measuring ~35 mm in longest dimension and weighing 13.7 g. The fragment is ~85% plagioclase with a uniform composition of $An_{91.5-91.9}$. Orthopyroxene occurs in granular clusters (where, locally, it comprises 60-70% of the area) with plagioclase at either end of the fragment and comprises ~15% of the sample. The orthopyroxene varies in composition from $Wo_{17}En_{52}Fs_{31}$ to $Wo_4En_{58}Fs_{38}$ (with some of the higher Wo contents attributable to fine clinopyroxene lamellae) and shows little core to rim variation (Figure 3; next page). Clinopyroxene occurs both as exsolution lamellae ($Wo_{40}En_{41}Fs_{19}$) in orthopyoxene and as less common individual grains ($Wo_{36-40}En_{41-43}Fs_{18-21}$). Individual clinopyroxene grains also contain exsolution lamellae of orthopyroxene. Using mineral-chemical criteria [2,3], this sample is likely a **ferroan anorthosite**.

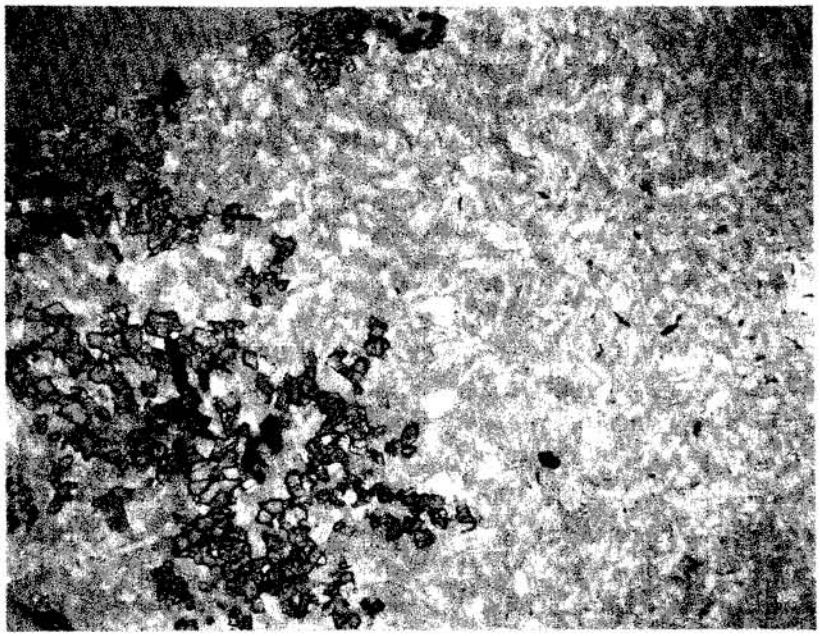

Figure 2

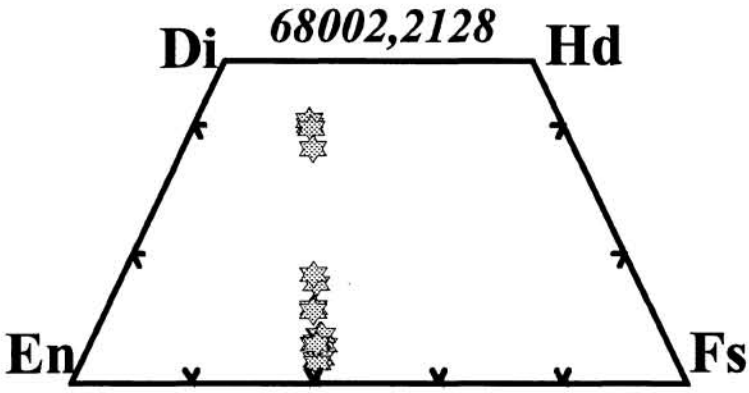

Figure 3: Pyroxene Quadrilateral

FUTURE STUDIES OF "FERROAN ANORTHOSITE" ***68002,2128*** – This fragment could be classified as a ferroan anorthosite. The granular texture is suggestive of metamorphism due to meteorite impact, but its uniform texture and mineral-chemical compositions suggest that it is monomict. However, INA analyses are being performed in order to confirm the pristinity of the sample and determine if the incompatible elements are in line with those of ferroan anorthosites [4]. The high mafic mineral content (~15%) of this sample, relative to other known ferroan anorthosites, may also allow the age of this rock to be accurately determined using the Sm-Nd isotopic technique. Since a precise age has been determined on only one ferroan anorthosite (60025; [5]), such a determination would be paramount to an understanding of early lunar crustal genesis.

REFERENCES: [1] Ulrich, G.E. et al., editors (1981) *USGS Prof. Paper 1048*, 539 pp.; [2] Warren, P.H. (1990), *Amer. Mineral. 75*, 46-58; [3] McGee, J.J. (1993), *JGR-Planets 98*, 9089-9105; [4] Warren, P.H. and Wasson, J.T. (1978), *PLPSC 9th*, 185-217; [5] Carlson, R.W. and Lugmair, G. (1988), *EPSL 90*, 119-130.