REVERSED POLARITY REMANENT MAGNETIZATION IN A LAYERED BOULDER NEAR SOUTH MASSIF. S.K. Banerjee, K. Hoffman and G. Swits, Dept. of Geology and Geophysics, Univ. of Minnesota, Minneapolis, Minnesota 55455.

The Apollo 17 astronauts collected oriented samples representing three distinct layers from Boulder 1 near Station 2 during A-17 EVA. This 2m-sized breccia boulder is unique because of its layering and its dark clasts which have anorthositic cores. We have made paleomagnetic measurements to determine the average directions and intensities of natural remanent magnetization (NRM) of the matrix of two layers, approximately 1 m apart.

The mutually oriented large (each approx. 3g in wt.) samples studied were 72275,46; 72275,47; 72275,56, and 72255,33 and 72255,36. The first three samples represent a less indurated layer than the non-porous layer which yielded the last two of the above samples. The present study was limited primarily to (a) the search for the average intensities and directions (if any) of NRM as recorded in the matrix of the two layers prior to studying the clasts embedded in them and (b), a secondary set of experiments utilized 100 mg chips to measure the high field saturation magnetization (σ_S), coercive force (H_C) and isothermal remanent magnetization (IRM_{SAT}). Given an understanding of the magnetization process, group (b) experiments provide a quantitative estimate of the iron (Fe°) content and a qualitative idea of their grainsize.

Fig. 1 (enclosed) shows an equatorial projection of the NRM vector directions from three matrix sub-samples of 72275 (46,47 and 56) and two matrix sub-samples of 72255 (33 and 36). Mutual orientation information was available from sample photographs and from page 24 of _The Lunar Sample Information Catalogue - Apollo 17_. The average NRM directions of the two rocks (each representing a different layer from the same boulder) are seen to be antiparallel to each other. It is estimated that orientation errors can be no larger than ± 20°. Another remarkable fact is that samples, in contrast to most other lunar samples, have unusually homogeneous remanent intensities (Table I) and coherent NRM directions (Fig. 1). In Table I we show the values of various magnetic properties of the 3g and 100 mg sub-samples of 72275 and 72255. Saturation magnetization (σ_S), coercive force (H_C) and saturation isothermal remanent magnetization (IRM_{SAT}) were measured only for the 100 mg ("chip") sub-samples. NRM values of the larger samples indicate 72275 to have an order of magnitude larger intensity than 72255. σ_S values indicate that half of this increase can be attributed to a greater iron content in 72275 (∿ 1.72% by wt.) than in 72255 (0.36%). This is corroborated by IRM_{SAT} data. The other half of the specific NRM increase in 72275 may be attributed to a larger number of more efficient carriers of NRM.

In a terrestrial situation we would ascribe the antiparallel NRM directions to a reversal of the magnetizing field (field-reversal) or a self-reversal, the latter being due to some type of magnetic interaction between two, or more, magnetic phases. However, before considering such speculation it is necessary to first conduct storage tests and partial alternating field (AF) or thermal demagnetization experiments in order to establish whether the reversed directions are indeed stable. We have thus far only completed a storage test (> 40 days in zero field) and, fortunately, unlike many lunar rocks, these samples do not show a decay of NRM with time. That is, there is no sign of an unstable Viscous Remanent Magnetization (VRM). Since AF-demagnetization has been shown to impart irregular error signals in some lunar rocks, we are proceeding with thermal demagnetization in a H_2/CO_2 gas buffer system suitable for preventing the oxidation of iron grains while thermal demagnetization is in progress. The data from thermal demagnetization will be presented at this conference. Until then, our tentative conclusion is that the two rocks, 72275 and 72255, were magnetized antiparallel to each other. If we assume that the NRM is a thermoremanent magnetization (TRM) and these divergent directions are not due to self-reversal (a safe assumption when iron is the magnetic carrier), then the two layers must have been magnetized (i.e., cooled from above 770°C) at different times. More specifically, upon the onset of a field-reversal, the terrestrial dynamo (size $\sim 10^3$ km) takes about 5×10^3 yr. to completely reverse its dipolar field. If we assume the ancient lunar magnetizing field to also be due to such a dynamo then, purely by analogy, these two rocks must be that much different in age.

The following scenario emerges for the formation of the South Massif, based on a hypothesis by J.A. Wood. A large cratering event (possibly the Serenitatis basin-forming event) created a base-surge type deposit of mineral debris and clasts. The layers represent different effective thermal conductivities. The passage of the 770°C isotherm (and resultant imprinting of NRM) from the layer containing the 72275 samples to that of the 72255 samples took place during a reversal of the ambient magnetic field. Alternatively, if future non-magnetic data force us to accept a truly simultaneous magnetizing events for both the layers, an ambient magnetic field of a most peculiar geometry has to be postulated and can be provided by an irregular source of dc field such as a local dynamo in the shallow part of the crust or in the dusty plasma in the base-surge.

TABLE I

Magnetic parameters of 72275 and 72255 samples

Sub-sample No.	NRM	σ_s	H_c	IRM_{SAT}
72275,46	2.40×10^{-4} emug^{-1}			
72275,47	1.30×10^{-4} emug^{-1}	1.72 emug^{-1}	$\sim$25 Oe	7×10^{-3} emug^{-1}
72275,56	1.09×10^{-4} emug^{-1}			
72255,33	1.23×10^{-5} emug^{-1}			
72255,36	1.17×10^{-5} emug^{-1}	0.36 emug^{-1}	$\sim$18 Oe	2.3×10^{-3} emug^{-1}

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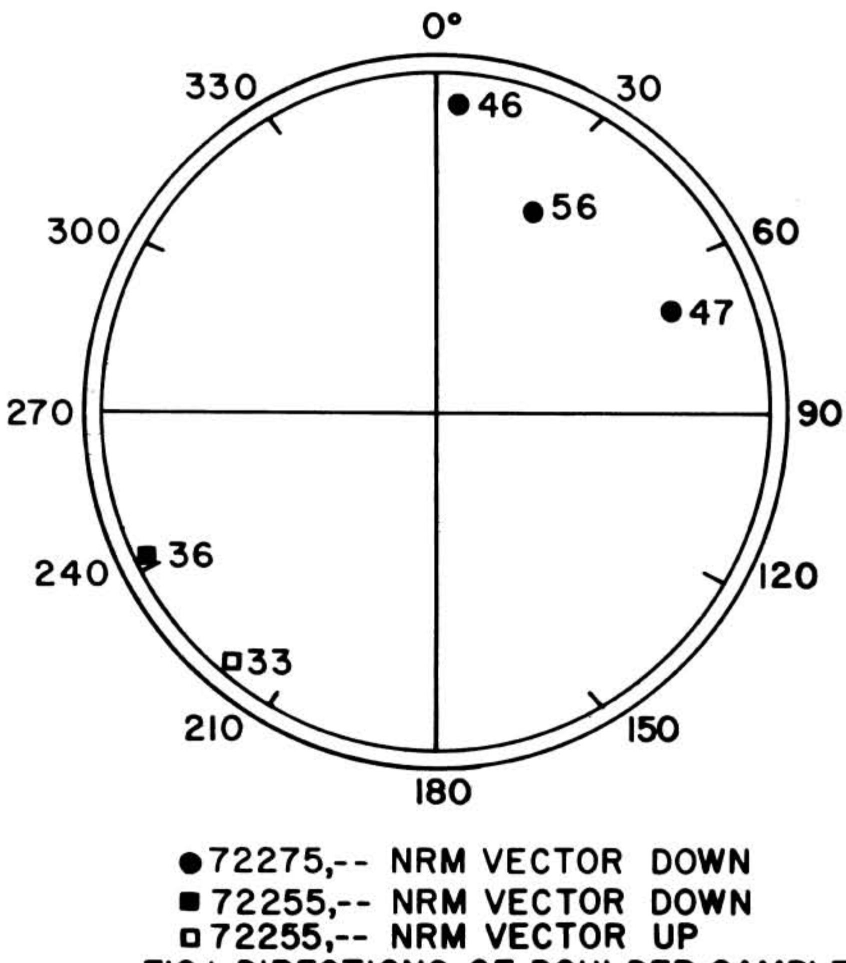

FIG.1 DIRECTIONS OF BOULDER SAMPLE