APOLLO 14 REGOLITH BRECCHIAS AND SOILS: COMPARATIVE PETROLOGY AND CHEMISTRY; S.B. Simon¹, J.J. Papike², S.S. Hughes², R.A. Schmitt², and J.C. Lau³,¹Inst. for the Study of Mineral Deposits, S.D. School of Mines and Technology, Rapid City, SD 57701-3995, ²Depts. of Chemistry and Geology and Radiation Center, Oregon State Univ., Corvallis, OR 97331, ³Chemical Technology Dept., Battelle, Richland, WA 99352

Previous studies of regolith breccia-soil suites from the A-11 [1], A-12 [2], A-15 [3], and A-16 [4] sites have each revealed site-specific features. For example, at the A-15 site, the regolith breccias are chemically very similar to the local soils [3,5], but in the case of A-12 [2] samples, the petrologic components used to model the soils did not work for most of the breccia compositions. This is because regolith compositions at a site may change with addition and removal of material, and because some breccias are exotic to their collection sites and represent otherwise unsampled regolith. Among the present samples, 14315 and 14318 were classified by [6] as "shocked, transported" breccias, based on chemical and petrographic contrasts with other A-14 regolith samples. Also, differences in glass populations among the breccias [7] may indicate different source regoliths for the breccias. We have conducted a chemical-petrologic study of ten A-14 regolith breccias to allow detailed comparison with the present-day regolith, to determine how many of the breccias formed locally, and to improve our understanding of the evolution of the A-14 regolith.

Breccia modes are compared to an average of five surface soils in Fig. 1. Because compaction can destroy agglutinates [8] shocked breccias (14307, 14315, 14318) have been averaged separately from unshocked breccias. The shocked breccias have much less recognizable fused soil (agglutinates + regolith breccias) than the unshocked breccias. The porous breccias have more fused soil than most lunar regolith breccias [1-4], indicating formation from relatively mature regolith (for regolith breccias) but they still have a lesser fused soil component than the present-day A-14 regolith. When the data are recalculated to a fused soil-free base (Fig. 1) the higher lithic contents of the breccias further indicate that they contain relatively immature material compared to the present-day regolith. This is typical of locally-formed breccias, which remain the same while their source regoliths become more mature with continued exposure.

Some compositional features of the breccias and soils are shown in Fig. 2. The present results and those of [9] show that most of the breccias are compositionally similar to the soils. The breccia with high Al₂O₃ and low MgO, TiO₂, and K₂O relative to the other samples is 14315, one of the "transported" breccias of [6], who also noted these differences. The sample with low Al₂O₃ is 14307, also a shocked breccia. The compositional similarity extends to the REE contents, again with the exception of 14315. As Fig. 3 shows, most of the breccias have patterns that are very similar to or overlap with those of A-14 soils.

Of the ten samples studied, seven are porous breccias that were formed at or near the A-14 site. Of the three compacted breccias, only 14315 formed from a regolith significantly different from the present-day A-14 regolith. If the other compact breccias, 14307 and 14318, were transported, then they probably formed from similar regolith elsewhere within the Fra Mauro Formation. The compositional similarities of the breccias and soils show that the A-14 regolith, unlike the A-15 and A-17 regoliths, is well-mixed and has been since before the formation of the breccias.
COMPARATIVE MODAL PETROLOGY OF A-14 SOILS AND BRECCIAS (1000-80 μm)

COMPOSITIONS OF A-14 REGOLITH BRECCIAS AND SOILS

Figure 1

References: