Mechanisms of lithification of lunar breccias

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Most lunar rocks studied to date are breccias of one form or another. The nature of the "glue" that bonds the fragments together and the processes by which an unconsolidated material becomes a non-porous, highly coherent breccia are poorly understood. Previous work on lunar impact melt rocks has investigated the relationships between the melt and cooler clasts. Textural studies have also been made on coarser grained breccias and melt rocks, which modeled temperatures, chemical changes and lithification as a result of shock. Fine-grained friable lunar breccias have also been studied using a scanning electron microscope to determine mechanisms of lithification. This study complements previous studies in that a range of lunar breccias, from impact melt to the very friable feldspathic breccia, have been examined from the Apollo missions 15, 16, and 17. In addition, samples of howardite and diogenite meteorites were used for comparison. Laboratory synthesized breccias were used as a control for shock conditions.

There appears to be a strong link between the friability of a lunar breccia, the porosity and the amount of intergranular melt. As the amount of intergranular melt increases, the sample becomes more coherent and the porosity decreases. Since the intergranular melt is generated by the energy released by an impact event, there must be a correlation between the friability of the rock and its distance from the impact or its source energy of lithification. This is complicated by the fact that on the moon, and other planetary bodies, it is likely that many impact events have affected the same rock. However, a sample should record the largest, closest and most recent event more strongly than other distant weaker, older events. It is thereby proposed that one can model the relative distance from the point of impact through the textural examination of a sample on the basis of intergranular melt, porosity, and friability.