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Irregular Mare Patches (IMPs): 100 Ma or 3 Ga?

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IMPs exhibit a perplexing combination of characteristics that are consistent with either a ~100 Ma or 3 Ga formation. Dozens of small-area IMPs have crisp morphologies and crater size-frequency distributions (SFDs) that denote relatively recent geologic activity (<100 Ma); however, the apparently well-developed regolith on portions of the IMPs are in conflict with such a young age [1]. To test possible formation hypotheses (e.g., [1-5]), which range from ancient volcanism to contemporary outgassing, we examined IMP morphology at the meter-scale with LROC NAC images and derived elevation models. We focused on the largest IMPs (Ina, Sosigenes, Cauchy, Maskelyne, and Nubium), where contacts between deposits are best developed. Most of our observations are consistent with multiple generations of inflation and breakouts (or squeeze-ups) of basaltic lavas that were affected by local slopes. Some of the extrusions coalesced into larger mounds or filled pre-existing craters. We did not observe evidence of large-scale void space (e.g., fissures, fractures, linear depressions, or pits) within or beneath the mounds or rougher deposits (e.g., [5]). But, small-scale voids may be signified by isolated pitted textures. We also did not detect evidence of the cooling fractures or lava plates expected in young lava flows and observed in lunar impact melt deposits. The smooth texture of the mounds is enigmatic. Block-less craters suggest at least 5 m of friable or poorly-cohesive material (such as regolith), yet mound margins exhibit slopes > 30° requiring significant material strength. Blocks are not common on the mounds, but are sometimes excavated by impacts (usually excavated from beneath the mounds). The uneven deposits are equally enigmatic and texturally varied (blocky, pitted, and crenulated). They are deficient in superposed craters compared to the mounds. If the mounds are indeed of similar age to the rougher units, then their different superposed crater morphologies and SFDs need to be explained by factors other than their ages. Any mounds originally composed of friable surface materials would evolve differently from more coherent deposits (e.g., [6-7]).

[1] Braden et al. 2014, [2] Strain and El Baz 1980, [3] Schultz et al. 2006, [4] Garry et al. 2012, [5] Head et al. 2016, [6] Schultz et al. 1977, [7] van der Bogert et al. 2010