Impact Basins and Crustal Evolution

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Previous models of the effects of larger scale impacts on early (~ 4.6 – 3.8 Ga) terrestrial crustal evolution have relied on analogies with the moon. Impact melt volumes, however, exceed transient cavities volumes at diameters > 400 km on Earth, compared to > 3000 km on the moon. At these sizes, terrestrial impact basins formed in strengthless melt pools and would not have the "traditional" morphology of lunar multi-ring basins. The Earth's earliest crust was likely basaltic. Basaltic bodies in the terrestrial environment differentiate, as a function of thickness. Thus, these multi-kilometer deep melt pools would have differentiated, in much the same manner as the Sudbury Igneous Complex in the ~ 250 km diameter Sudbury Structure. The largest envisaged impact event(s) would have resulted in the production of ~ 0.5 x 10^9 km^3 of felsic differentiates. Averaged over the ~ 800 Ma of "heavy bombardment", this is ~ 30% the present annual rate of growth of continental crust. The character of the earliest continental crust is speculative, but the partial melting of hydrated oceanic crust beneath some unspecified buoyant crust is a common theme for the production of the earliest tonalitic and trondhjemitic rocks. The felsic differentiates of the large impact melt pools are candidates for this buoyant crust and may have played a role in the formation and evolution of protocontinents.