Objective

Investigate interior effects of the lunar South Pole-Aitken (SPA) impact and its relationship with the origin of the antipodal Procellarum KREEP Terrane (PKT)\(^1\) (Fig. 1).

**Figure 1:** Lunar map of topography with surface volcanic deposits outlined in red\(^2\). The South Pole–Aitken (SPA) basin is delineated in black and white. Modified from [3].

Background

- The SPA impact likely occurred within 200 Myr after the possible global lunar magma ocean\(^{[3-5]}\).
- The SPA impact is suggested to have induced migration of magma ocean residuum (urKREEP)\(^{[5-7]}\) and caused antipodal seismic effects\(^{[6, 9]}\), contributing to PKT formation.

Model

- CitcomS (a 3D thermochemical evolution code)\(^{[10, 11]}\) is combined with a shock heating model from [12] to simulate an SPA-sized impact in a laterally homogeneous Moon.
- Nominal lunar model parameters\(^{[13]}\) and various initial thermal states are used (Fig. 2).
- Mantle temperature is limited to 1850 K.

Results

- In all cases, the impact-heated mantle material rises and spreads laterally beneath the surface, which is accommodated by an upwelling beneath the impact site (Fig. 2).

**Figure 2:** Thermal state of the lunar interior before, immediately after, and 20 Myr after simulating an SPA-sized impact. Irregularity near the core is an initial perturbation given to each thermal profile. Bottom of (a-c) shows temperature isosurfaces at 1600 K (outer) and 1800 K (inner) with a static sphere representing the core. Initial temperature profile in (d) is adapted from [4, 14] and all isosurfaces are at 1800 K.

Implications

- Post-impact lateral advection of subcrustal material from the region of SPA may provide a mechanism to transport urKREEP.
- Long-term behavior may concentrate urKREEP in the PKT by direct transport to the impact antipode or by redistribution of farside urKREEP deeper into the mantle.

Future Work

- Study long-term (200 Myr+) effects of impacts.
- Investigate effects of an Imbrium-sized impact and multiple consecutive impacts.
- Consider detailed profiles for temperature, density, viscosity, and radiogenic heating.
- Incorporate models to track migration of urKREEP.

References