

Subsurface-to-Surface Material exchange as a result of Impact cratering.

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Surface-to-subsurface exchange of material on solar system bodies is of vital astrobiological importance as it facilitates the mixing of subsurface water and surface oxidants, combining two elements necessary for the formation of life as we know it. It also brings information of subsurface conditions to the surface, for observation by spacecraft, allowing us to better understand the subsurface properties and processes of remote bodies. The process of impact crater formation produces several avenues for this material exchange: First, and most obviously, the impactors penetrate down into the target, excavating the subsurface and ejecting it to sometimes far-flung distances across the surface. This ejecta will include a sample of layers from different depths and different distances from the impact point, including melted target material - liquid water on ice-rich bodies.

The produced impact crater will host a warmed highly brecciated interior - a prime location for hydrothermal activity and fluid flow between breccia fragments. The fractures created by impact, and that form due to the response of a planetary crust to a new impact crater, can reach down from the surface across a wide area - sometimes a significant portion of the host body (e.g. Valhalla's multi-rings on Callisto). Each fracture presents an avenue for this important surface-to-subsurface interchange. The deepest material excavated by impact is that at the crater center, exhumed as part of the central uplift. Each of the material exchange mechanisms listed here depend on a variety of factors, including the presence of layering. This invited talk will present visualization of these subsurface-to-surface pathways, formed by a variety of impact scenarios in layered targets.