

THE NUCLEAR RETARC SULKY - AN UPSIDE DOWN CRATER

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Sulky, an 85-ton nuclear cratering experiment, was detonated 90 ft below the surface of the dry basalt at Buckboard Mesa, Nevada Test Site on 18 December 1964 as part of the U.S. Plowshare Program. The resulting mound, called a retarc (crater spelt backwards), was roughly symmetrical with an average radius of 80 ft, beyond which the ground surface was upthrust and fractured for at least another 40 ft. The mound contained a central “depression pit” averaging 24 ft in radius and 21 ft high with the floor only 9 ft above surface ground zero. The resulting measurements and analysis achieved the original objective of helping to define the nuclear rock cratering curve beyond optimum depth of burst. Viewed from the surface the Sulky mound appeared as a “jumbled pile” of basalt blocks sized by pre-existing joint surfaces. However, trenches cut through the mound revealed a well defined structure below the surface. A new effort was launched 1988 to map in detail the structure exposed by the trenches and individual basalt blocks on and beyond the mound. With good stratigraphic control provided by preshot corings, individual basalt layers were mapped across the mound showing upthrusting increasing until intersected by the “depression pit” which is actually an “ejection pit” and the primary source of the jumbled surface covering of the mound. New analysis of the high-speed cinema followed the mound rise and then tracked many of the individual ejecta blocks exiting at high angles from the central portion of the mound, the “ejection pit”. Close correlation of these data provided an excellent benchmark for both centrifuge experiments and 2-D finite difference and discrete element calculations which nicely bounded the observables. Together the synthesis of all these efforts provided a dynamic link for better understanding the formation of the Sulky retarc and show just how close Sulky was to being a crater.