THE LATE DEVONIAN ALAMO IMPACT BRECCIA, SOUTHEASTERN NEVADA

by

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ABSTRACT

The Alamo breccia, discovered in 1990, is an Upper Devonian sedimentary carbonate megabreccia that has been mapped in 13 mountain ranges in southeastern Nevada. The voluminous deposit accumulated during a single, but complex, event, and lies within the Frasnian *punctata* conodont Zone. As presently known it forms a westward open, north-south-extending semicircle divided into three concentric zones. Prior to this study, evidence for the extraterrestrial impact origin of the Alamo breccia included its unusual epiplatform position, impact-generated shocked quartz grains, and an iridium anomaly.

As determined in this study the Alamo breccia covers an area of ~15,200 km^2, decreases in thickness from 106.5 m in the center or Zone 1 to 0.6 m in the periphery or Zone 3, and contains a volume of ~590 km^3. From Zone 3 towards Zone 1 the breccia overlies increasingly older beds, having cut more deeply into the carbonate platform. Across Zone 2, a thin detachment interval of probable shock-wave origin forms the base of the deposit. The breccia is composed of several internal beds of decreasing thickness, separated by scour surfaces. The beds were formed by consecutively weaker subevents, corresponding to diminishing water surges of waning impact-generated tsunamis that repeatedly reworked the upper part of the breccia. The character of the breccia ranges from disorganized slide deposits and debrites near the base to one or more graded turbidites near the top.

The Alamo breccia appears to consist mainly of resedimented carbonate-platform material. An exception are accretionary spherules, identical in texture to pyroclastic accretionary lapilli, but composed primarily of carbonate particles. The spherules contain shocked quartz grains and are interpreted to have formed during the Alamo event. Accretionary carbonate spherules were aero- and hydrodynamically sorted and deposited as ejecta beds. These beds were mainly destroyed by the multiple tsunamis. However,

parts of the ejecta beds were preserved as spherule clasts within the breccia by processes interpreted as synsedimentary reworking.

Breccia thickness and average clast size decrease across the carbonate platform towards the periphery of the deposit. Radially divergent flow directions in Zone 3 and convergent flow directions in Zone 2 suggest that Zone 1 lies close to if not in the crater. In Zone 1 intrusive clastic dikes and sills, exhibiting rock liquefaction and fluidization features, and shock metamorphism of quartz grains in the bedrock all suggest close proximity to the impact site.

The sedimentary features of the Alamo breccia compare extremely well with those predicted by a synthetic model (Oberbeck et al., 1993) for shallow-water impact crater and extra-crater stratigraphy: in Frasnian time an impact occurred in southeastern Nevada. Impact shock-waves migrated from the target site and disturbed surface sediments and subsurface beds. Slumps and water surges, caused by impact-generated tsunamis, promoted further mixing and bedrock brecciation. Early-stage ejecta blankets, represented by the accretionary spherules in the Alamo breccia, were reworked into the accumulating deposit. Overall, the impact formed a concentrically zoned and systematically varying deposit.

Compared to other marine impactites worldwide, the Alamo breccia is unique, not only for its size and its above-mentioned characteristics, but also for its excellent exposures. Research on the Alamo breccia may prove essential for comparison with, and/or the detection of, other mass-flow deposits or diamictites of potential impact origin. Confirmation of the Alamo impact event in the Frasnian may also have consequences for the multiple impact theory for mass extinction during the Late Devonian.

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