MILK SPRING CHANNELS PROVIDE FURTHER EVIDENCE OF OCEANIC, >1.7-KM-DEEP LATE DEVONIAN ALAMO CRATER, SOUTHERN NEVADA. C. A. Sandberg[1], F. G. Poole[1], and J. R. Morrow[2], [1]Geologist Emeritus, U.S. Geological Survey, Box 25046, MS 939 and 973, Federal Center, Denver, CO 80225 (sandberg@usgs.gov and bpoole@usgs.gov), [2]Department of Earth Sciences, University of Northern Colorado, Greeley, CO 80639 (jared.morrow@unco.edu).

Introduction: Milk Spring, the locality that yielded a 6-cm-long accretionary bomb ejected by the Alamo Impact, is now found to contain the farthest offshore, stratigraphically deepest breccia-filled channels [1-2]. Current directions of these and other off-platform channel-fill deposits (Figs. 1–2) indicate southeastward (craterward) transport. Recent work shows this crater had a final diameter of 44–65 km and was excavated to a depth of >1.7 km but was later dismembered and buried beneath younger rocks [2]. Allochthonous and semi-autochthonous polymict breccias resulting from the marine impact are now exposed in nearly 20 mountain ranges in southern Nevada. They were emplaced in roughly semicircular belts of

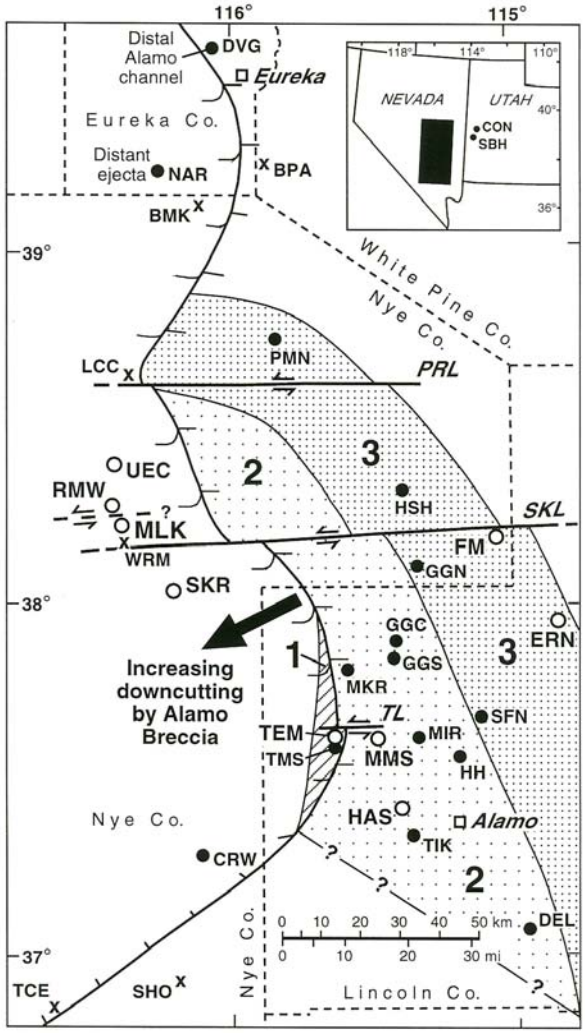

Figure 1 – Partly restored paleogeographic map showing distribution of Alamo Breccia (AB) Zones 2 and 3 on, and Zone 1 just off, carbonate platform; crater-filling channels at localities SKR, MLK, RMW, and UEC seaward of platform; and megatsunami uprush or backwash deposits on platform at DVG in Nevada and at CON and SBH (inset map) in Utah. AB localities are shown by circles, open circles are localities depicted in Fig. 3, and non-AB localities are shown by crosses.

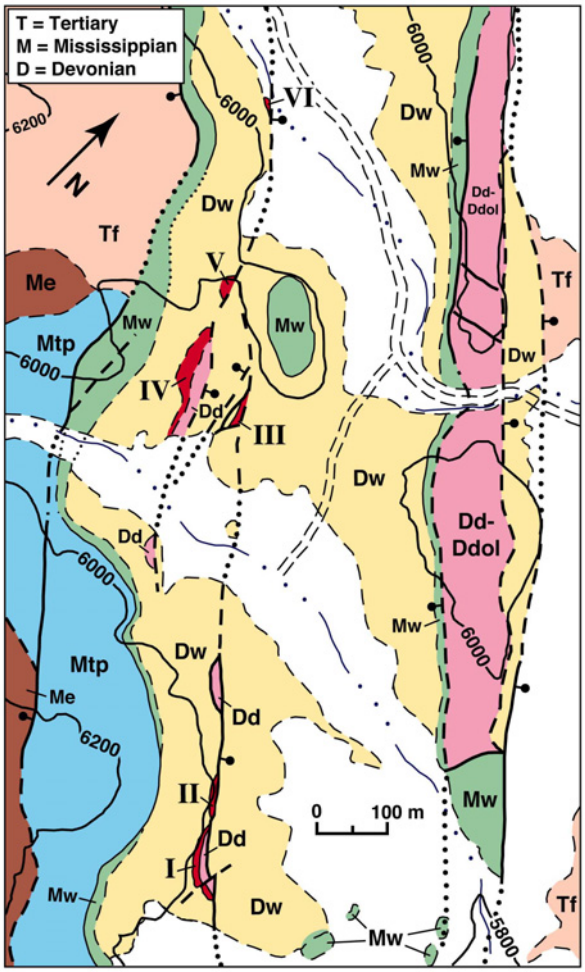

Figure 2 – Simplified geologic map of Milk Spring area, southern Hot Creek Range, Nevada. Six separate outcrops of 8-m-thick Alamo Breccia channel-fill deposits (I-VI) are exposed for a distance of 1 km along two NW-trending normal faults. Tf, volcanic flow; Me, Eleana Fm; Mtp, Tripon Pass Ls; Mw, Webb Fm; Dw, Woodruff Fm; Dd, Denay Ls; Dd-Ddol, Denay Ls-Devonian dolostone. Note direction of North arrow.

shoreward-thinning megabreccia and tsunamite deposits, designated Zones 1, 2, and 3, across the early Late Devonian carbonate platform and adjacent slope (Fig. 1). Megatsunami uprush and/or backwash deposits are now documented on the carbonate platform beyond the outermost Zone 3 at Devils Gate (DVG), Nevada, and in the Confusion Range (CON) and South Burbank Hills (SBH), Utah (Fig. 1).

Milk Spring channel-fill deposits: Alamo Breccia deposits, averaging 8 m thick and comprising several upward fining cycles, are mapped in six small outcrops in a distance of 1 km along two NW-trending normal faults east of Milk Spring, near the south end of the Hot Creek Range, Nevada (Fig. 2). These deposits, which represent several discrete channels are overlain by the ribbon chert member of the Upper Devonian Woodruff Formation and underlain by the Middle Devonian Denay Limestone, as described at Warm Springs, where the Alamo Breccia is absent at an unconformity, 5.6 km to the south [3]. At Milk Spring, underlying beds at the top of the Denay are dated by conodonts as Eifelian *kockelianus* Zone (Fig. 3). Ejected Ordovician conodonts, carbonate lapilli, an ejecta bomb, and a likely Ordovician alga *Receptaculites* have been found at several of the outcrops.

Interpretation: The Alamo Breccia truncated at least 500 m of stratigraphic section from coeval rocks of the early Frasnian *punctata* Zone on the carbonate platform through Givetian rocks to those of the middle Eifelian *kockelianus* Zone within the basinal and slope Denay Limestone (Fig. 3). The westward slope of the base of the Alamo Breccia points to a deep-water, off-platform Alamo Impact site, particularly considering that the deep-water channels display southeastward (craterward) transport directions. Given the uniform seaward slope of the Breccia base across the platform, it would be difficult to interpret a platform-margin impact site such as east of Tempiute Mountain (TEM).

References: [1] Morrow et al. (2001) *LPI Contribution 1080*, Abstract #1018. [2] Morrow et al. (2005) *GSA Spec. Pap. 384*, *in press*. [3] Sandberg et al. (1997) *BYU Geol. Stud., 42:1*, 129–160.

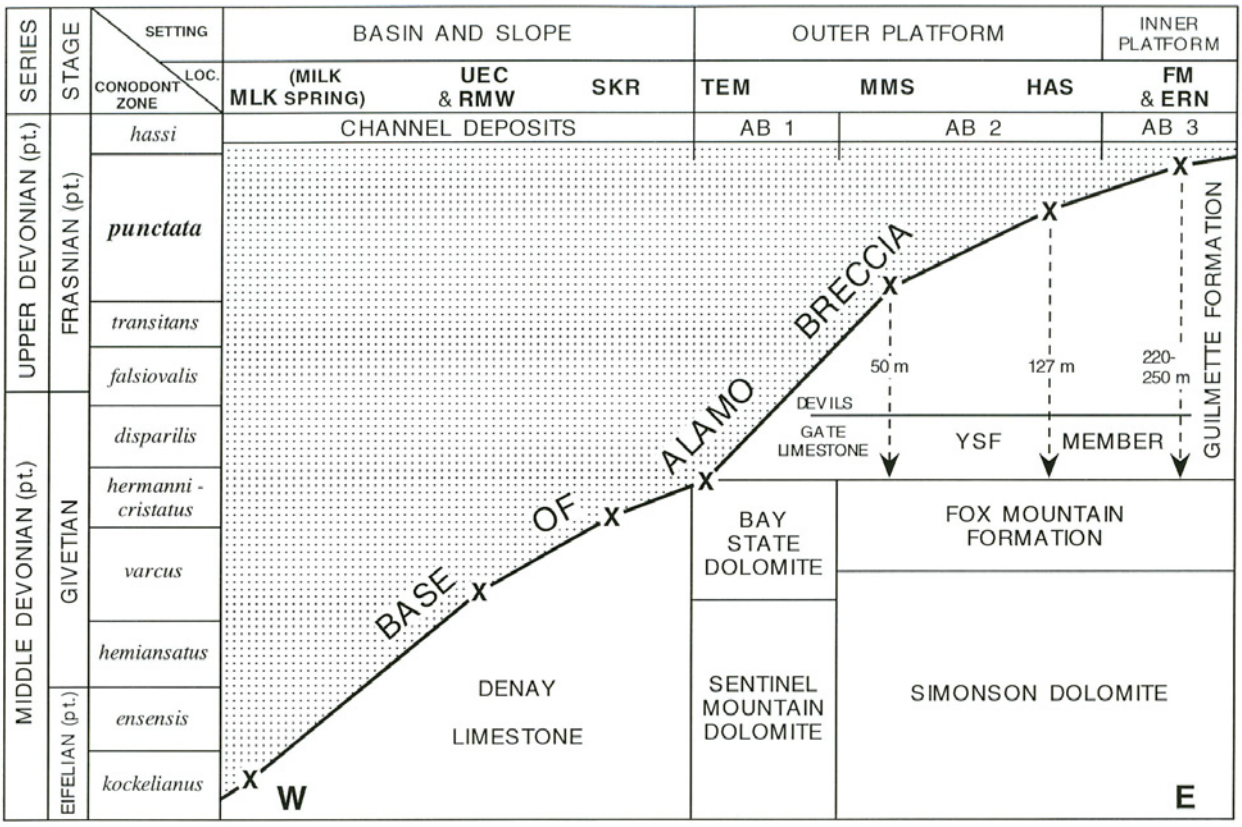

Figure 3 – Diagrammatic cross section depicting stratigraphic downcutting at base of on- and off-platform Alamo Breccia deposits. Downcutting of >250 m within rocks of *punctata* Zone across carbonate platform by seaward-sliding debrites and tsunamites is by actual measurements to base of yellow-slope-forming member (YSF) of Guilmette Formation and Devils Gate Limestone. Additional downcutting of >250 m into Denay Limestone downslope into basin is based on conodont dating of beds directly below bases of SE-directed crater-filling channel deposits.