

REVISED DATING OF ALAMO AND SOME OTHER LATE DEVONIAN IMPACTS IN RELATION TO RESULTING MASS EXTINCTION. J.R. Morrow¹ and C.A. Sandberg². ¹Dept. of Earth Sciences, Univ. of Northern Colorado, Greeley, CO 80639. E-mail: jared.morrow@unco.edu. ²U.S. Geological Survey, Box 25046, MS 939, Federal Center, Denver, CO 80225.

Introduction: The stepwise Late Frasnian (mid-Late Devonian) mass extinction is one of the five largest Phanerozoic extinction episodes. High-resolution data presented by numerous workers indicate that stepwise, progressive biodiversity loss is a fundamental characteristic of Phanerozoic mass extinctions. Late Devonian data, which must now be re-examined in light of new radiometric and conodont biochronologic dating, suggest that multiple sub-critical impacts coincided with significant biodiversity losses, culminating in an end-Frasnian mass extinction.

Late Devonian Impacts: The early Late Devonian Alamo impact is dated by conodont biochronology as early Frasnian *punctata* Zone. Previously this was converted to a date of ~367 Ma. However, recent radiometric dating by Kaufmann and colleagues [1,2] of the Late Devonian, which closely parallels dating by Tucker et al. [3], has necessitated redating the Alamo impact as ~382 Ma. The Alamo impact targeted a marine, off-platform (~300-m-deep) site in south-central Nevada [4]. Although the crater has been tectonically dissected and dislocated and later buried, the evidence for impact is well documented, e.g., [4,5,6,7]. Conodont dating of the Flynn Creek impact structure, Tennessee, by Schieber and Over [8] suggests the next older *transitans* Zone, ~1 m.y. older than the Alamo impact, although their recorded conodont species are permissive of a *punctata* Zone age. However, a critical conodont collection [9], now apparently lost, from a currently inaccessible outcrop within the structure may suggest an age younger than the *transitans* Zone. The Amönau possible impact event [10,11], Germany, is dated by conodonts as *falsiovalis* Zone, which is the next older, early Frasnian, pre-*transitans* zone. Calibration of the *falsiovalis* Zone age for the Amönau event against the revised Late Devonian time scale [1,2] indicates a numeric age of ~383.5 Ma. The Siljan impact, Sweden, is dated numerically as ~376.8 Ma +/- 1.7 m.y. [12]. This dating is either coincident with, or just before, the Late Frasnian mass extinction, at ~376.1 Ma +/- 1.6 m.y. [1].

Conclusion: These new numeric dates confirm that a series of Frasnian impacts, interpreted as comet showers [11], accompanied and probably promoted progressive, low-latitude biodiversity loss, culminating with ecosystem collapse that produced the end-Frasnian mass extinction.

References: [1] Kaufmann B. et al. 2004. *Journal of Geology* 112:495–501. [2] Trapp E. et al. 2004. *Geology* 32(10):857–860. [3] Tucker R. D. et al. 1998. *Earth and Planetary Science Letters* 158:175–186. [4] Morrow J. R. et al. 2005. *Geological Society of America Special Paper* 384:259–280. [5] Warme J. E. and Sandberg C. A. 1995. *Courier Forschungsinstitut Senckenberg* 188:31–57. [6] Leroux H. et al. 1995. *Geology* 23:1003–1006. [7] Warme J. E. and Kuehner H.-C. 1998. *Intl Geology Review* 40:189–216. [8] Schieber J. and Over J. D. 2004. *Geological Society of America Abstracts with Programs* 36(5):160. [9] Huddle J. W. 1963. *U.S. Geological Survey Professional Paper* 475C:C55–C57. [10] Ormö J. 1994. *Berg & Dal Bladet* 3:9–10. [11] Sandberg C. A. et al. 2002. *Geological Society of America Special Paper* 356:473–487. [12] Reimold W. U. et al. 2004. Abstract #1480. 35th Lunar & Planetary Science Conference.