Science
AAAS

Comment on "Impact Ejecta Layer from the Mid-Devonian: Possible Connection to Global Mass Extinctions"

Grzegorz Racki, *et al.*

Science **303**, 471b (2004);
DOI: 10.1126/science.1090332

The following resources related to this article are available online at www.sciencemag.org (this information is current as of November 26, 2009):

Updated information and services, including high-resolution figures, can be found in the online version of this article at:
http://www.sciencemag.org/cgi/content/full/303/5657/471b

A list of selected additional articles on the Science Web sites **related to this article** can be found at:
http://www.sciencemag.org/cgi/content/full/303/5657/471b#related-content

This article **cites 6 articles**, 1 of which can be accessed for free:
http://www.sciencemag.org/cgi/content/full/303/5657/471b#otherarticles

This article appears in the following **subject collections**:
Geochemistry, Geophysics
http://www.sciencemag.org/cgi/collection/geochem_phys
Technical Comments
http://www.sciencemag.org/cgi/collection/tech_comment

Information about obtaining **reprints** of this article or about obtaining **permission to reproduce this article** in whole or in part can be found at:
http://www.sciencemag.org/about/permissions.dtl

Downloaded from www.sciencemag.org on November 26, 2009

Science (print ISSN 0036-8075; online ISSN 1095-9203) is published weekly, except the last week in December, by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. Copyright 2004 by the American Association for the Advancement of Science; all rights reserved. The title *Science* is a registered trademark of AAAS.

Comment on "Impact Ejecta Layer from the Mid-Devonian: Possible Connection to Global Mass Extinctions"

The interesting report by Ellwood *et al*. (*1*) demonstrated the applicability of magnetic susceptibility field methods to the identification of distal impact deposits. However, the evidence that they have presented for a bolide impact during the Middle Devonian, immediately preceding the Eifelian-Givetian (E-G) stage boundary at ~380 million years ago (Ma), requires further confirmation and, in particular, better evidence for shock metamorphism. The images identified by Ellwood *et al*. (*1*) as shocked quartz grains are not convincing, and the orientation measurements suffer from an insufficient number of observations. The possible presence of an extraterrestrial component also needs confirmation: As and V anomalies are certainly not indicative of a cosmic component, and Ir data, which would be more characteristic, are absent.

Even if there were strong evidence for a mid-Devonian impact, the interpretation presented by Ellwood *et al*. (*1*) would be too far-reaching in one key respect. In the title of the report, Ellwood *et al*. announce a possible cause-and-effect relation between the putative bolide impact and a global mass extinction. This extinction in question is the late Eifelian Kacák/*otomari* event (*2*–*4*). Ellwood *et al*. claim that this biospheric perturbation "may represent the extinction of as many as 40% of all marine animal genera" (*1*). They cite the work of Sepkoski (*5*) as their only reference for this claim, but the 40% figure is not derived from this work. The crucial figure 6 from Sepkoski (*5*) illustrates the extinction pattern of only "well-preserved" marine genera during the Devonian substages, and the E-G passage is marked by demise level of approximately 15% (Fig. 1). More significant, however, is that this so-called mass extinction of the late Eifelian is at the sixth position among the Devonian intervals in a relative ranking, and has only half the magnitude of the peak that marks the late Frasnian event, a true mass extinction. Indeed, Walliser (*2*) characterized the impact-related Kacák/*otomari* biotic crisis as a minor two-step event that constituted at most a third-order extinction limited primarily to pelagic biota. Its main cause is seen to be the anoxic conditions recorded in widespread, long-lasting (perhaps 1 million years in duration) black-shale deposition during a pulse of marine transgression (*2*–*4*). The sulfide-forming and redox-sensitive trace metals, reported by Ellwood *et al*. (*1*) as evidence for an impact, may be alternatively thought as a geochemical signature of oxygen deficiency only.

Altogether, the term "global Kacák/*otomari* mass extinction" is an original proposal of Ellwood *et al*. (*1*), and an overestimate of the actual biotic changes at this stratigraphic horizon. Similarly negligible ecosystem collapse, at least in an immediate feedback, is established for the well-dated mid-Frasnian Alamo impact event in Nevada (*6*). The insistent search for causal link between an extraterrestrial impact of unknown magnitude and an obligatorily major extinction represents a circular argument [see, for example, (*7*, *8*)], and such a link has not been demonstrated in this case.

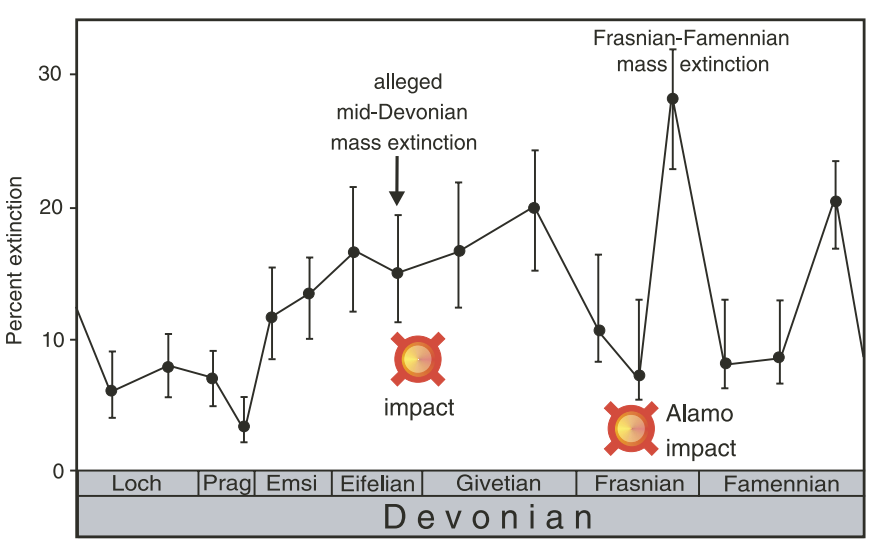

Fig. 1. Two selected impact events plotted against percent extinctions of "well-preserved" marine genera through 16 substages of the Devonian [adapted with permission from figure 6 of Sepkoski (*5*); copyright © 1996 by Springer-Verlag]. As in the original diagram, end-stage extinction data are not plotted at the graphed stage boundary lines, but slightly before them. Loch, Lochkovian; Prag, Pragian; Emsi, Emsian.

Grzegorz Racki
Department of Earth Sciences
University of Silesia
PL-41-200
Sosnowiec, Poland
E-mail: racki@us.edu.pl

Christian Koeberl
Department of Geological Sciences
University of Vienna
Althanstrasse 14
A-1090 Vienna, Austria.
E-mail: christian.koeberl@univie.ac.at

References and Notes

1. B. B. Ellwood, S. L. Benoist, A. El Hassani, C. Wheeler, R. E. Crick, *Science* **300**, 1734 (2003).
2. O. H. Walliser, in *Global Events and Event Stratigraphy in the Phanerozoic*, O. H. Walliser, Ed. (Springer-Verlag, Berlin, 1996), pp. 225–250.
3. R. Schöne, *Göttinger. Arb. Geol. Paläont.* **70**, 1 (1997).
4. M. R. House, *Palaeogeogr. Palaeoclimatol. Palaeoecol.* **181**, 5 (2002).
5. J. J. Sepkoski Jr., in *Global Events and Event Stratigraphy in the Phanerozoic*, O. H. Walliser, Ed. (Springer-Verlag, Berlin, 1996), pp. 35–51.
6. A gradually more destabilized Frasnian marine ecosystem by series of comet showers is hypothesized in (9), and the Frasnian-Famennian mass extinction is suggested in (*10*) to have been triggered by a rapid global cooling that followed Alamo impact–produced anomalous greenhouse interval.
7. A. Hallam, P. B. Wignall, *Mass Extinctions and Their Aftermath* (Oxford Univ. Press, Oxford, 1997).
8. The subsurface Woodleigh impact structure in Western Australia (of disputed size; diameter estimates range from around 40 km to 120 km) was first linked to the Permian-Triassic mass extinction and later to the Late Devonian mass extinction [see (*11*)], but neither time of impact nor its magnitude seem yet to be well constrained (*12*).
9. C. A. Sandberg *et al*., *Geol. Soc. Am. Spec. Pap.* **356**, 473 (2002).
10. G. R. McGhee Jr., *Palaeogeogr. Palaeoclimatol. Palaeoecol.* 176, 47 (2001).
11. S. D. Uysal *et al*., *Earth Planet. Sci. Lett.* **192**, 218 (2001).
12. P. R. Renne *et al*., *Earth Planet. Sci. Lett.* **201**, 247 (2002).

11 August 2003; accepted 2 December 2003

Downloaded from www.sciencemag.org on November 26, 2009