Geophysical Research Abstracts, Vol. 7, 11196, 2005
SRef-ID: 1607-7962/gra/EGU05-A-11196

Flood basalts appear to be the main cause of biological mass extinctions in the Phanerozoic

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There is in our view no question that a large impact hit Earth 65 million years ago and created the Chixculub impact crater, generating a large number of geological, geophysical and geochemical anomalies at the global scale: this is the stratigraphic level where iridium is generally found and which is now used to define the Cretaceous-Tertiary (KT) boundary. We note that J. Phipps Morgan argues for massive explosive eruptions ("Verneshots") as the agent of these anomalies, and that G. Keller believes that the Chixculub impact predated the paleontological boundary by a few hundred thousand years, but these are (even more) controversial, and we will not need them in our argument.

The first major line of thought has been to go from the single, intensely studied case of the KT boundary to the general case of all major mass extinctions in the Phanerozoic, in order to get "more than one point on the curve". We do not hypothesize a priori that there was a single cause to all mass extinctions. We simply follow Occam's razor and start looking whether a simple mechanism, asteroid or comet impact, massive volcanic eruption or other, can account for most of the available data. A major observation has been the increasingly successful correlation between the ages of flood basalts and those of mass extinctions, to which it has been found that oceanic anoxia events (OAE) should be added. The correlation was first introduced some 15 years ago and has been reviewed several times since. It has systematically improved as more data came in (particularly more numerous and accurate absolute ages) and the latest compilation (Courtillot and Renne, 2003) shows that each one of the last 4 major mass extinctions can be accurately associated in time with a flood basalt, with no miss. Moreover many other flood basalts are associated with a "smaller" extinction event, or in the case of submarine volcanism with an OAE. There is almost no flood basalt which does not have an associated event in the last 300 million years of Earth history. In contrast, only one impact (at the KT) correlates with a mass extinction, and that is at a time. Data from India show that volcanism predated impact and therefore the latter could not be a consequence of the former. Data arguing for a second impact/extinction pair at the Permo-Triassic boundary have been strongly criticised, whereas presence of and correlation with the Siberian flood basalts are convincing. Also, rather large impacts are found that have led to no extinction whatsoever. So, a Chixculub size event may be much rarer than previously thought and the only one that is associated with a mass extinction occurred when volcanism and extinction were already on. It can therefore be argued that the impact-related part of the mass extinction event was due to added instantaneous stress on an already heavily stressed biosphere.

It has long been asserted that fissural basaltic eruptions could not have a global climatic impact. Recent work has shown that this was not the case. Detailed reconstruction of the history of volcanism during the 1783 Laki eruption in Iceland (Thordarson and Self, 2002), one of the largest historical fissural eruptions (15 km3 of lava in ten eruptive episodes spread over 9 months), has shown that it was directly responsible for some of the worst climatic change in a century in the northern hemisphere, leading to massive pollution, an "awesome" sulfur-rich dry haze, and deaths in western Europe (and not only locally in Iceland, where effects were even worse), probably 20 times more than during the summer of 2003 heat wave. Stratospheric transport of sulphuric aerosols is now understood to be the prime agent of these changes, leading to hemispheric, and possibly in worse cases global distribution. A flood basalt consists of hundreds of flows, each possibly hundreds of times larger than the Laki. A 1000km3 flow could possibly erupt in on the order of only 10 years, leading to hardly imaginable fluxes. SO2 in the short term, more than CO2 in the longer term, could be the main agent of climatic change, pollution and biological harm. Obtaining better constraints on the detailed timing of flow sequences in the traps, and modelling the resulting climatic impact at time scales from years to hundreds of thousands of years is one of the next research frontiers (Chenet et al, 2005).