Geophysical Research Abstracts
Vol. 16, EGU2014-14342-1, 2014
EGU General Assembly 2014

High-precision temporal constraints on intrusive magmatism of the Siberian Traps

Seth Burgess (1), Sam Bowring (1), Volodia E. Pavlov (2), and Roman V. Veselovsky (2)

(1) Massachusetts Institute of Technology, United States (sburgess@mit.edu), (2) Institute of the physics of the earth, Russian Academy of Sciences. Bolshaya gruzinskaya st. 10, Moscow 123995, Russia

The broad temporal coincidence between large igneous province magmatism and some of the most severe biotic/environmental crises in Earth history has led many to infer a causal connection between the two. Notable examples include the end-Permian mass extinction and eruption/emplacement of the Siberian Traps large igneous province (LIP) and the end-Triassic mass extinction and the Central Atlantic Magmatic Province. In models proposing a causal connection between LIP magmatism and the environmental changes that lead to mass extinction, gases and particulates injected into the atmosphere are thought to cause abrupt changes in climate and ocean chemistry sufficient to drive mass extinction of marine and terrestrial biota. Magmatism has been proposed to cause voluminous volatile release via contact metamorphism of the sedimentary rocks. In the case of the Siberian Traps LIP, the compositions of sedimentary rocks (carbonates, evaporates, organic-rich shales) that host sills and dikes are ideal for greenhouse gas generation. When coupled with the enormous volume of Siberian LIP intrusive rocks, there is the potential for volatile generation on a scale necessary to drive environmental changes and mass extinction.

This model must be tested by comparing the timing of intrusive magmatism with that of the mass extinction. Coupled high-precision geochronology and astrochronology have constrained the timing of biotic crisis and associated environmental perturbations from the deca-millennial to sub-millennial timescale, suggesting that the biotic crisis was abrupt, occurring over < 100 ka. Published geochronology on sills and dikes from the LIP are sparse and lack the necessary precision to resolve the relative timing of the two events outside of age uncertainty.

We present new high-precision U-Pb zircon geochronology on seventeen gabbroic sills from throughout the magmatic province. This includes samples from the mineralized and differentiated intrusions in the Noril'sk region, from the central portion of the magmatic province and from the massive sills in the southern region of the LIP, where many intrusions are associated with eruptive pipes proposed to be the main mechanism by which volatiles are injected into the upper atmosphere. Weighted mean 206Pb/238U dates have uncertainties that range from $\pm$ 44 to 180 ka. Such precision allows resolution of the relative timing of sill emplacement and the extinction interval outside of analytical uncertainty, allows the timescale of changes in the global carbon cycle to be compared to that of the LIP, and permits evaluation of the role of intrusive magmatism in the mass extinction and during the post-extinction biotic recovery interval.