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Contact metamorphism associated to the magmatic plumbing system, the main responsible of the impact on environment of the large igneous provinces ?

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Some large igneous provinces (LIP) coincide with global warming episodes and major mass extinctions but others do not. The Cretaceous-Tertiary mass extinction coincides with flood volcanism in the Deccan province of India; the Permian-Triassic extinction with the emplacement of the enormous Siberian Traps; and the End-Guadalupian mass extinction with the Emeishan LIP. In contrast the enormous oceanic plateaus and the Karoo flood basalts had lesser effects on the biosphere. It has been suggested that the cooling effect of volcanic ash and sulphate aerosols injected into the stratosphere during large Plinian eruptions may be the main cause of mass extinctions but the volume of erupted basalt of each large igneous province does not correlate well with the extent of mass extinction. Furthermore, the released CO2 is too 13C enriched to explain the available proxy data. It has been suggested that the global climatic changes associated with large igneous provinces may be related to the type of intruded rocks rather than the volume of erupted magmas (Svensen et al. (2004) Nature 429, 542; (2007) EPSL 257, 554). Contact metamorphism of sedimentary rocks around subvolcanic sills may release large quantities of greenhouse and toxic gases (CO2, CH4, SO2) into the atmosphere.

The Panzhihua mafic-ultramafic sill, part of the Emeishan LIP, intruded a series of dolostones, shales, and sandstones at 261 Ma. The sill is surrounded by a 450m-thick contact aureole composed mainly of brucite (originally periclase)-bearing marble. Gas production potential associated with the contact metamorphism of dolostone can be es-

timated based on the prograde mineral reactions and the aureole volume. A minimum production potential of CO2 is 16 Gt, estimated from the extent of periclase formation in the 450m–thick aureole. The estimate does not take into account the CO2 released by lower temperature reactions, by the complete breakdown of carbonates in the inner aureole, or thermogenic methane released from organic matter. The ∼400 km3 volume of the Panzhihua sill is ∼1/2000 of the ∼1 million km3 volume of the Emeishan magmatic suite which implies that the total CO2 production potential during Emeishan magmatism exceeded several thousand Gt. In contrast, using the approach of Self et al. (2006, EPSL 248, 518), the amount of magmatic CO2 released from the Panzhihua intrusion itself was less than 5.6 Gt. The generated metamorphic carbon gases likely vented to the atmosphere on a short timescale, utilizing the permeability structure created during the emplacement event. The vented CO2 would have led to escalated greenhouse conditions, and contributions from thermogenic gases could have created the documented end-Guadalupian negative carbon isotope excursion.