Composition and Age Groups of the Central Atlantic Magmatic Province Relative to the Tr-J Extinction Event

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Basalts of the Tr-J Central Atlantic Magmatic Province (CAMP) had an extrusive volume estimated to exceed 2 million km3, spread over 10 million km2 within four continents, and centered upon but extending far outside of the initial Atlantic rift zone of Pangaea. Tholeiites comprise nearly all CAMP magmas, divided among three compositional super-groups. The most common are several variations of quartz tholeiites with intermediate TiO2 and MgO values (labelled ITi), which occur along with Fe-enriched fractionates throughout most of the province. Low TiO2/high MgO olivine and quartz tholeiites (LTi) are abundant in the western CAMP area (primarily southeastern USA), and variably high TiO2/low MgO (HTi) sub-alkaline tholeiites are concentrated in the east-central region (Liberia and northern Brazil). Some magmatic members of these suites occur in individual dike systems and basin lavas that can be correlated across the modern Atlantic.

Dates for HTi basaltic intrusions are variable, perhaps due to pervasive alteration, but they may be as much as 10 m.y. younger than other CAMP magmas. ITi volcanics in the northern CAMP, as constrained by radiometric ages and stratigraphy, are essentially between 200.5 and 201.6 Ma and now known to date from the end of the Triassic Period into the earliest Jurassic. At least a small portion appears to slightly precede the mass extinction near the Tr-J boundary. LTi basaltic intrusions of the southeastern USA have radiometric dates too similar to the ITi dates to distinguish them. However, they have mainly NW-SE dike trends that are crosscut by N-S ITi dikes, which strongly indicate a distinct and older age for the LTi activity – possibly by only a few hundred thousand years.

Sulfur in LTi olivine basaltic dikes and sills averages 0.067 % by weight, which is twice as high as the ITi quartz basalt average, and volcanic H2SO4 aerosols are known to cause world-wide cooling events. A sudden large emission of volcanic sulphur would be catastrophic in an ecosystem adapted to a hot-house Earth. These CAMP olivine basalts had sufficient size, location, timing, and emissions to be the potential cause of the Tr-J mass extinction.