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The Choiyoi silicic large igneous province of Argentina and Chile and its possible linkage to middle Permian climate change and mass extinction

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Large igneous provinces (LIPs) form episodically in Earth's history by the eruption of large volumes of basaltic magma over geologically brief intervals of time. Along continental margins or interiors large igneous provinces can be dominated by silicic volcanic activity to produce silicic large igneous provinces (SLIPs). Most LIPs appear to be plume related features linked to continental breakup and coincide with global mass extinctions. Here we recognize the Choiyoi magmatic province of central and southern Argentina and Chile (23°-42°S) as a SLIP based on 1) its aerial extent of ~500,000 km^2 and variable thicknesses up to at least two kilometres ranking it amongst the largest SLIPs recognized on earth, 2) its dominant rhyolite-ignimbrite composition and volcanological record of plinian or ultraplinian eruption capable of injecting large volumes of material into the stratosphere, 3) the correlation of Choiyoi magmatism to widespread Permian ashfalls in Gondwana terrestrial basins including the Paraná and Karoo basins, and 4) the strongly episodic record of Choiyoi magmatism as documented here based on a substantial new body of zircon U-Pb ages.

The relatively small database of radiometric age determinations by a variety of methods (K-Ar, Ar-Ar, Rb-Sr, U-Pb) for the vast Choiyoi SLIP has established a generally accepted view of the Choiyoi as having a protracted record of Permian-Triassic magmatic activity spanning ~50 million years. Here we report 26 new laser ablation ICP-MS zircon ages for the Choiyoi SLIP from two key transects in Argentina from central Mendoza (32°S) and San Juan (33°S) where local mapping, volcanological, and stratigraphic studies have been undertaken. These data define a strongly bimodal age distribution with peaks at ~248 Ma and 266 Ma. The older peak dominates the distribution encompassing 20 of the 26 ages that are statistically indistinguishable and which yield a weighted mean age of 265.9±1.0 Ma (95% conf.). This includes ~266 Ma emplacement ages through >1.4 km thick sections in each transect that attest to rapid generation and emplacement of silicic magmas.

The pronounced ~266 Ma 'flareup' in Choiyoi magmatism is corroborated by a compilation of zircon U-Pb ages for volcanic samples collected over much of the extent of the province (25°S -40°S) (Fig. 1) as well as detrital zircon U-Pb age peaks in middle Triassic and Neogene sedimentary basins. The ~266 Ma peak represents a short duration (~1-6 m.y.) outburst of silicic volcanic activity that overlaps with several major events occurring

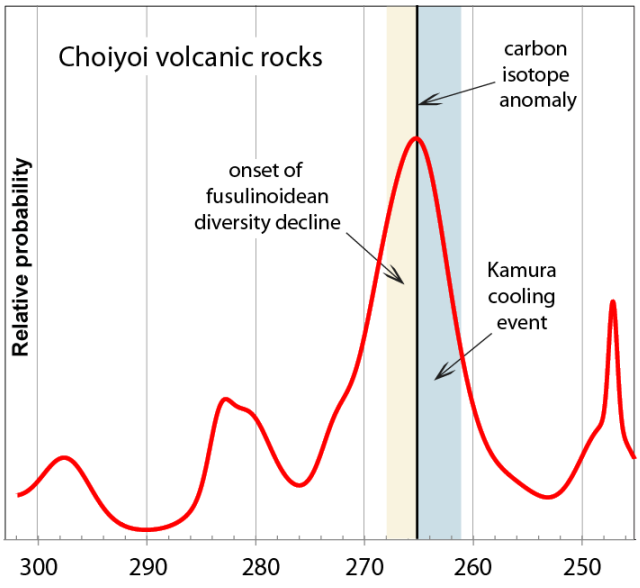

Figure 1. Relative age probability curve for compilation of 63 zircon U-Pb ages from Choiyoi volcanics (in red) with selected global climate events.

around this time that include, 1) Olson's extinction event marking the transition from basal synapsids to terapsids , 2) a global negative carbon isotope anomaly at 265.5 Ma, 3) a decline in diversity of fusulinoids, 4) the beginning of the Kamura cooling event, and 5) high atmospheric CO_2 levels. Many of these events are conceivably the product of volcanism requiring that the Choiyoi SLIP receive careful consideration as a driving force for these phenomena.