New Zircon U-Pb Ages for the Choiyoi Silicic Large Igneous Province of Argentina that Define a Strong Episodic History of Magmatism and Mass Extinction in the Permo-Triassic Time

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Abstract
The Choiyoi magmatic silicic large igneous province (SLIP) of central and southern Argentina and Chile (23°S–42°S) was emplaced along the eastern edge of Gondwana in Permo-Triassic time. This magmatic province qualifies as a SLIP due to: 1) areal extent of ~500,000 km² and variable thickness of at least two kilometers; 2) dominated rhyolitic-ignimbrite composition; 3) the correlation of Choiyoi magmatism to widespread Permian ash falls; and 4) strongly episodic magma record over ~30 m.y. The 26 new zircon U-Pb ages span the Choiyoi rocks from two key transects in Mendoza (32°S) and San Juan (33°S) define strong bimodal age distributions with peaks at ~246 Ma and 266 Ma. The older peak dominates the distribution, encompassing 20 of 26 ages that are statistically indistinguishable and which yield a weighted mean age of 265.9 ± 1.0 Ma (95% conf.).

Introduction
Major volcanic episodes have been accused of complicity in mass extinctions throughout geologic history. Four of the top five mass extinctions, as well as every major event since the Permian have been correlated with major volcanic eruptions. These major volcanic events represent large igneous provinces, which are defined as magmatic provinces ~100,000 km² in size, volumes of ~100,000 km³ and a maximum duration of 50 million years. Large igneous provinces are characterized by igneous bodies of short duration (~1–5 m.y.), during which a large portion of the province is erupted. The significance of rhyolitic (silicic) large igneous provinces in the geologic record has not been extensively explored. The signification of rhyolitic (silicic) large igneous provinces in the geologic record has not been extensively explored.

Link to Choiyoi Magmatism
The largest extinction event in the history of the planet occurred at the end of the Permian, when over 95 percent of marine and 70 percent of terrestrial species were eliminated in a geologic instant (Erwin, 1994). Despite intense research on the Permian-Triassic boundary interval for several decades, the cause of the end-Permian extinction remains controversial. The synchronicity between the end-Permian extinction and the emplacement of the large igneous province in southern Pangea has long been recognized, but the impact of these low volatile (~5%) magmas on the environmental composition is debated. The influence of rhyolitic, high volatile (~15%) silicic large igneous complexes, such as the Permian-Triassic Choiyoi magmatic system of the southern Andean Mountains, on end-Permian environmental change has not been studied, and magmagenic atmospheric composition has not been extensively explored.

Phanerozoic marine biodiversity
Permian-Triassic boundary mass extinction

Enormous caldera-forming eruptions, such as those documented in the Yellowstone hotspot system and those that probably toppled the Choiyoi magmatic magnetic province, can eject 2000–2500 km³ of volcanic ash, with measurable ash layers distributed worldwide. Such eruptions could eject ~10⁷ tons of H₂O, CO₂, SO₂, HCl essentially instantaneously into the atmosphere, with potentially catastrophic environmental consequences. The distinct bimodal age distribution within the Choiyoi Group, with major peaks of eruptive activity at 246 and 266 Ma, precisely brackets the peak Permian extinction event at 252 Ma. It is herein suggested that the Choiyoi magmatic system, with its strong bimodal age distribution and eruption of ~10⁷ tons of volcanic ash, is a candidate for a significant cause of the end-Permian extinction event along with other proposed causal factors.