Tectonic events of the Taconic Orogeny elucidated through LA-ICPMS studies of volcanic zircons, southern Appalachians, USA

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Despite a long history of stratigraphic work, many questions remain about the tectonic setting of the Taconic orogeny during the early late Ordovician. Several different global paleogeographic hypotheses exist about the tectonic driving force that led to the early stages of this orogeny in the Southern Appalachians. While some studies suggest that the closing of the Iapetus ocean was caused by the collision of the North American and South American plates, most studies suggest that island arc systems collided with the passive continental margin of North America. Nevertheless, disagreement exists on how to explain the stratigraphic architecture of the siliciclastic sequences representing the erosion of the Taconic Highlands in an island arc setting. Some studies suggest the collision was analogous to the modern Banda Arc system with the development of a foreland basin and a sedimentary wedge, while other studies call for the presence of a back arc basin. Here we present geochemical results of volcanic zircons that are associated with the magmatic activity during this time. Previous studies focused on slender zircons for age dating. However, in this study we analyzed several large zircons from close to the volcanic center in Alabama that have inherited cores in order to test for tectonochemical evidence of multiple crustal events and the tectonic setting.

While the rims have ages consistent with the Taconic Orogeny (~450 my), the cores have much older ages (~1000 my). Our results support the hypothesis that during the closing of the Iapetus ocean, Precambrian and Cambrian sediments from the passive continental margin were subducted and incorporated into the volcanic system. This led to the inclusion of Precambrian zircons into melts associated with the Taconic Orogeny. Overall, our study supports the presence of subduction of preexisting sedimentary rocks and potentially the presence of a sedimentary wedge. Ongoing geochemical studies aim at developing better understanding of the melt composition during the volcanic events.