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Exploring the pre-eruptive history of the Central Atlantic Magmatic Province (CAMP) and the link with the end Triassic extinction using high precision U-Pb zircon and baddeleyite geochronology

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The Central Atlantic Magmatic Province (CAMP) is a massive outpouring of basaltic lava, dykes and sills that was predominantly emplaced into the Triassic-Jurassic basins of North and South America, Europe and Africa. These basins were, at the time, in the center of the paleo-supercontinent Pangea, and the CAMP flood basalts are associated with Pangea's break-up and the opening of the Atlantic Ocean. The global climatic and environmental impact of the basalt eruption has been temporally linked with the end-Triassic mass extinction, although the extinction horizon, defined by a carbon isotope excursion, is stratigraphically below the first basaltic flows in all of the currently identified basins. Therefore, if the extinction is related to the CAMP, it must be related to a process that occurred before the eruption of the first basalt flow, or is co-incident with a currently unidentified older basalt flow.

Here we present high precision TIMS zircon U-Pb geochronology on zircons from the North Mountain basalt (NMB) in the Fundy basin, Canada, and also baddeleyite from the Foum Zuid dyke (FZD) in the Anti-Atlas, Morocco. The NMB zircons have been separated from the lowermost accessible basalt flow of the NMB sequence in a coarse-grained section, rather than from a felsic residual melt pod, which is the usual target for zircon geochronology in basalts. The baddeleyites from the FZD were also separated from a coarse-grained section of the dyke. The zircons and baddeleyites from the NMB and FZD samples contain an antecrystic population with ages more than 1 Ma older than the emplacement of the basalts. The U-Pb ages presented here suggest that there was magmatic activity relating to the CAMP before the eruption of the first basalts. There are a number of possible explanations for the old zircons 1) recycling of zircon from earlier phases of magmatism, which then would have to have been re-molten and entrained into the NMB and FZD magmas. 2) Recycling of crystal mush from the same magmatic system indicating that the system stayed at temperatures which enabled the magmas/crystal mushes to stay saturated in zircon and baddeleyite. 3) The older zircons are all xenocrysts or inherited cores from earlier magmatism.

The identification of antecrystic zircon and baddeleyite in the basalts has significant implications for the relationship between the CAMP and the end Triassic extinction. Recycling of older Zr-phases, which crystallized earlier in the magmatic system that produced CAMP basalt melts, also bear important information on the chemical and physical dynamics of the magmatic plumbing system of the CAMP flood basalt province. We present geochronological information, CL images, and Hf isotopic information to support our interpretations for the origins of these important grains.