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Arctic volcanism during the Palaeocene and Eocene: The timing and provenance of volcanic ashes in the Central Tertiary Basin, Svalbard

Morgan Jones (1), Seth Burgess (2), Gauti Eliassen (1), Henrik Svensen (1), Sverre Planke (1,3), Malte Jochmann (4), and Bjarki Friis (4)

(1) University of Oslo, Centre for Earth Evolution and Dynamics, Department of Geology, Oslo, Norway (m.t.jones@geo.uio.no), (2) Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139-4307, USA, (3) Volcanic Basin Petroleum Research (VBPR AS), Forskningsparken, Gaustadalléen 21, 0349 Oslo, Norway, (4) Store Norske, Postboks 613, 9171 Longyearbyen, Svalbard, Norway

The Central Tertiary Basin (CTB) in south-central Spitsbergen, Svalbard, was deposited in a syn-orogenic strike-slip foreland basin that developed as the Arctic and North Atlantic spreading centres sought to merge during the early Cenozoic. Throughout the Palaeocene and Eocene sequence are prominent ash layers, preserved as bentonite clay horizons ranging from 1-30 cm in thickness. The provenance of these ashes is unclear, as considerable weathering and alteration has destroyed much of the original mineral assemblage. A total of 52 ash layers were sampled from nine cores, covering a wide area of the CTB. Distinct ash horizons were investigated for remnants of the primary minerals for dating and geochemical affinities. Whole-rock ICP-MS results suggest that even after distortion by weathering, original ashes are likely to have varied from basaltic to rhyolitic in composition. Pristine, euhedral zircons were U-Pb dated from a number of ash layers, although only some of the layers were found to contain zircons. A thick ash layer at the base of the succession was dated to mid-Palaeocene in age, and subsequent layers show that volcanism continued to affect the basin during the PETM. However, the majority of the volcanism is of mid- to late-Palaeocene in age. Unaltered feldspars were analysed by electron microprobe, with significant variance observed between layers. Some contained abundant sanidines, while others were dominated by plagioclase feldspars that were occasionally up to 80 % anorthite. Whole-rock rare earth element (REE) analyses normalised to chondrite show further differences between ash layers. Basal ashes have a large negative Eu anomaly, while subsequent ashes have either no anomaly or a slight negative anomaly. Most ashes (including those with an Eu anomaly) have a moderate La/Yb slope typical of an evolved melt, while occasional layers have a flatter slope more characteristic of a primitive melt. The basal ashes with a strong negative Eu anomaly match REE patterns from the Kap Washington Volcanic Province in North Greenland, suggesting this is the likely source. Later Palaeocene and Eocene ashes are likely to have originated from the spreading axes to south and/or northwest of Svalbard.