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Explosive venting of greenhouse gases from volcanic basins triggering major climate changes

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Emplacement of voluminous intrusive complexes in organic-rich sedimentary basins may cause global climate changes. We have recently proposed that the Initial Eocene Thermal Maximum (IETM) was caused by eruption of hundreds or thousands of Gt carbon from such volcanic basins in the northeast Atlantic. The gases were erupted through several thousand hydrothermal vent complexes identified on seismic and borehole data. The greenhouse gases were formed rapidly in metamorphic aureoles around volcanic sill intrusions emplaced into organic-rich sediments about 55 m.y. ago. The timing of the main intrusive volcanic event is constrained by well data and seismic mapping to be within the A. Augustum biostratigraphich zone, which is time-equivalent to the IETM. However, the time resolution is about 0.5 m.y., which is not precise enough for the ˜10 kyr time resolution required to accurately tie the vent complex formation with the IETM. We have recently proposed an IODP drilling leg on the mid-Norwegian margin with the aim of determining precisely the relative timing of the hydrothermal vent complex formation and the IETM. Core data may further document the temporal relationship between other short-lived warming events (e.g., the ELMO and X events) and distinct northeast Atlantic volcanic episodes in the late Paleocene and early Eocene. We have further recently conducted extensive fieldwork in two other volcanic basins test our hypothesis. New results show that the Toarcian global warming event (ca. 183 Ma) was temporarily associated with formation of hundreds of pipe structures and vent complexes in the Karoo Basin, South Africa, during the Karoo Igneous event. Similarly, emplacement of extensive sill and vent complexes in the organic-rich Tunguska Basin in Siberia was temporarily associated with the Permo-Triassic global warming and mass extinction event (ca. 250 Ma). In conclusion, our observations strongly suggest a causal correlation between short-lived global

warming episodes and intrusive volcanism. Detailed studies of the cause and consequences of these ancient global warming events may provide important insight into the consequences of potential future global warming episodes.