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Rapid emplacement of the Karoo Basin sill complex during the Toarcian revealed by U-Pb dating of zircons

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Volcanic basins are formed when large volumes of magma intrude sedimentary basins. Such basins contain complex and interconnected networks of sheet intrusions that are surrounded by contact aureoles of thermally matured sediments. Devolatilization reactions of organic matter and carbonate minerals in the contact aureoles cause rapid gas generation. The gases may either be trapped to form hydrocarbon accumulations or be released into the atmosphere to trigger global warming. Well-known volcanic basins include the Vøring and Møre basins offshore mid-Norway, the Karoo Basin in South Africa, and theTunguska Basin in Siberia. Currently, only few sills in these basins are accurately dated. Improved geochronology is important to establish a causal link between contact metamorphism and global environmental change. In order to test if sill complexes are rapidly emplaced in sedimentary basins we have completed a basin scale U/Pb geochronology study of zircons from dolerites in the Karoo Basin. We sampled 48 pegmatites found in thick sill intrusions from different parts of the basin, separated by as much as 1000 km. From fifteen widely separated samples, thirteen contained fresh euhedral and inclusion-free zircons suited for high resolution dating. The 13 U-Pb ages do all overlap within the uncertainty (average of +- 0.4 Ma). The mean age is 182.7 Ma, with a range from 182.3 to 183.0 Ma. The dated sills, regardless of their stratigraphic and geographic position, were all emplaced during time of the Toarcian carbon isotope excursion. The new high-precisions dates strengthen the hypothesis that sills in volcanic basins may cause global change by rapid production and release of greenhouse gases.