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New insights into the brittle evolution along the passive continental margin of Western Norway from U-Pb calcite dating

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We here present the first U-Pb geochronology from calcites precipitated on fracture and fault surfaces from the passive continental margin of Western Norway. The evolution of passive continental rifted margins is reflected in complex fracture and fault networks which have been activated and reactivated through time. Constraining the timing of fault activity and fracturing can assist in revealing the interaction between tectonic processes and the topographic response onshore. Recently, U-Pb calcite dating has proven to be a useful tool to complement other geochronological methods and to produce more complete records of brittle deformation in different geological settings. In this study, we collected 35 calcite samples from different fault and fracture planes in Western Norway, 14 of which gave reliable U-Pb dates. The onshore field area is located at the junction of the NE-SW trending Norwegian Sea and the N-S trending North Sea. 1) The oldest calcites measured are from the Dalsfjord fault, a complex brittle fault related to the Nordfjord-Sogn Detachment Zone. The ages obtained from a green cataclasite indicate fluid flow and calcite precipitation around 208 ± 25 Ma and 205 ± 6 Ma, whereas a reddish cataclasite and fault gouge zone were dated 142 ± 15 Ma. 2) Two calcite samples from the northern part of the study area were collected along fractures parallel to the Møre-Trøndelag Fault Complex and yield dates of 89 ± 4 Ma and 79 ± 3 Ma. 3) Five samples from variously oriented fractures and faults spread over the field area gave dates of 69 ± 2 Ma, 67 ±15 Ma, 65 ± 2 Ma, 64 ± 2 Ma and 59 ± 2 Ma. These ages can be linked to the base Tertiary unconformity in the offshore stratigraphic record of the northern North Sea interpreted to be caused by onshore uplift. Several processes have been proposed to cause a possible uplift during this time span; a) regional influence of the Icelandic mantle plume, b) rift footwall uplift, c) climatically controlled topographic changes. 4) Five samples from across the field area yield dates of 49 ± 3 Ma, 35 ± 1 Ma, 21 ± 1 Ma, 5.5 ± 4.5 Ma and 0.8 ± 0.1 Ma. All these calcites precipitated on faults and fractures striking NE-SW, and its formation may be related to relaxation along the passive margin. The dated calcites from this study provide Cenozoic brittle deformation ages much younger than previously obtained by other geochronological methods, possibly allowing to decipher the youngest brittle tectonic evolution of the margin in unprecedented detail.