



Comparing offshore and onshore thermal histories: low-T thermochronology of the Utsira High, western Norway

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The Utsira High is a basement horst in the northern North Sea, flanked to the west and east by the Viking Graben and Stord Basin respectively. The basement is composed of Caledonian granitic and gabbroic rocks. Since Caledonian times, the North Sea region has been affected by extensional tectonics leading to rifting, active fault tectonics and uplift of basement blocks. Extensive drilling due to recent hydrocarbon exploration has made the basement of the Utsira High accessible for thermochronological investigations that allow a direct comparison with the results from onshore studies.

Zircon (U-Th)/He, apatite fission track and apatite (U-Th)/He dating on seven samples from the Utsira High yielded Middle-Late Devonian, Late Permian-Late Jurassic and Middle Jurassic-Pliocene ages respectively, tracking cooling through successively lower closure temperatures and subsequent reheating during sedimentary burial since the Jurassic. Generally, basement rocks of the Utsira High reached near surface temperatures already in Carboniferous-Triassic times, much earlier than the oldest overlying sediments (Middle Jurassic-Cretaceous) might indicate. Onshore samples, on the other hand, generally cooled to near-surface temperatures in the Jurassic (coastal areas) or even later, in the Cretaceous-Cenozoic (inland areas). Only coastal areas experienced minor reburial followed by renewed exhumation in late Cretaceous-Cenozoic times.

Both the basement of the Utsira High and onshore western Norway are strongly dissected by faults. K-Ar illite fault gouge dating shows that many of these faults were active during rifting. However, fault activity continued during the Cretaceous-Cenozoic, long after rifting in the North Sea had ceased. Large fault systems separate crustal blocks with distinct thermal histories, suggesting that uplift, erosion and landscape evolution along the North Sea rift margin were strongly fault-controlled.