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Laser-Ablation Split-Stream (LASS) Petrochronology of the Ultrahigh-Pressure Western Gneiss Region

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Comprehensive geologic understanding of large-scale tectonic processes requires many detailed investigations at small scales distributed over large areas. Prior to the advent of LA-ICPMS, such collection of geochronologic data was impossible. We present a new laser-ablation split-stream (LASS) petrochronology dataset from the ultrahigh-pressure Western Gneiss Region (WGR) of Norway that now rivals structural and petrological datasets in richness and information content: >150 titanite samples, >50 zircon samples, >30 monazite samples, and >20 rutile samples.

The half of the WGR that is close to the foreland shows weak Caledonian deformation and preserves Precambrian Sm-Nd garnet ages, Precambrian U-Pb zircon ages, partially reset U-Pb titanite ages, 398–397 Ma U/Th-Pb monazite ages, and muscovite 40Ar/39Ar ages that decrease monotonically away from the foreland from 400 to 390 Ma. The hinterland is variably deformed and preserves three distinct UHP domains that are marked by 420–400 Ma Lu-Hf and Sm-Nd eclogite ages, 418–407 Ma Sm-Nd garnet ages from HP gneiss, 425–402 Ma U-Pb zircon ages from eclogite, 425–405 Ma monazite U/Th-Pb ages from garnet-stable gneiss, 430–415 Ma U-Pb zircon ages from HP gneiss, 407–392 Ma U-Pb zircon ages from exhumation-related leucocratic intrusions, 405–394 Ma U/Th-Pb monazite ages from post-UHP gneiss, 400–398 Ma U-Pb zircon ages from post-UHP gneiss, 405–375 Ma titanite ages, 395–372 Ma U-Pb rutile ages, and 390–375 Ma muscovite 40Ar/39Ar ages. In general, coherence among the age gradients defined by the different isotopic systems indicates simple east-directed exhumation. In detail, however, differences among the ages within the three UHP domains indicate juxtaposition of the central and northern UHP domains against the southern UHP domain after titanite and rutile closure and prior to muscovite closure.