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The Kongsberg-Modum terrane of Southern Norway: a key toward a refined conceptual model of the Sveconorwegian orogen

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The Sveconorwegian orogen corresponds to the part of Scandinavia affected by the Sveconorwegian orogeny between ca. 1140 and 900 Ma. The orogen is generally interpreted as resulting from the collision between Fennoscandia and an unknown large continent, possibly Amazonia. Its first-order architecture is defined by the juxtaposition of a series of crustal blocks, separated by major, ca. N-S trending ductile deformation belts. Our current research focuses on the Kongsberg/Modum terrane (KMT), a small lithotectonic block located in the middle of the orogen in Southern Norway. With a still ongoing multidisciplinary study of the terrane, we aim at unravelling its geological evolution and constraining its role in the orogen build up. The study combines detailed lithological and structural mapping, carried out digitally, with airborne, high resolution potential field geophysics and new geochronological and geochemical studies. The KMT is characterised by an elongate N-S trending structural grain that corresponds to highly flattened and isoclinally folded metavolcanic, metaplutonic and metasedimentary sequences. The Modum sub-complex is a quartzite-rich metasedimentary belt, and it includes characteristic sillimanite-quartzite and anthophyllite-cordierite gneiss. A sheared sinistral transpressive contact separates it from the Kongsberg sub-complex, formed predominantly by metavolcanic and plutonic rocks. Steep amphibolite-facies shear zones within and between these lithological belts also invariably show a sinistral transpressive component. Structural data collected along the KMT-Telemark boundary in the west show that the KMT is thrusted westward over the leucocratic granitoids of the Telemark sector along the Sokna-Saggrenda shear zone (SSSZ). The SSSZ is a curved, narrow and laterally continuous (ca. 100 km long) lower amphibolite facies shear zone accommodating an overall top-to-the-west transport, although local kinematic variations exist due to strain partitioning caused by the shear zone curved geometry. The top-to-the-west kinematics along the SSSZ is consistent with the westward-vergence of a variety of structures that accommodate overall E-W shortening and that are characteristic for the entire central and western Sveconorwegian orogen. With the goal to constrain in time this regional shortening phase, we dated the product of amphibolite-facies partial melting genetically linked to top-to-the west shears in the Idefjorden terrane, immediately to the east of the KMT. Seven leucosomes associated with and resulting from muscovite-, biotite- and amphibole dehydration melting, range in age from ca. 1039 to 997 Ma. U/Pb zircon geochronology along the KMT-Telemark boundary confirms that the juxtaposition of the two blocks is post c. 1170 Ma. Imbrication started at ca. 1080 Ma and is believed to mark the initiation of the actual collision. It led to progressive crustal thickening and caused in the study area HP granulite-facies metamorphism locally recording peak conditions of c. 930° C - 1.3 GPa at c. 1050 Ma. Still ongoing Ar-Ar investigations suggest that the KMT final emplacement along the SSSZ occurred at about 1000 Ma. After 970 Ma the SSSZ was overprinted by localised ductile top-to-the-E extension and, en route to the surface, by complex, multistage brittle reactivation during the Phanerozoic, leading to the formation of volumetrically extensive cataclasites and discrete gouge zones.
The available data support the interpretation that the KMT forms a remnant of a west-vergent accretionary wedge formed in a broad sinistral transpressive collision zone.