Geology, geochronology and geochemistry of the inner central Sesia Zone (Western Alps, Itlay)

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This study addresses three broad topics: 1) the metamorphic and tectonic history of the internal central Sesia zone (western Alps, northern Italy), 2) the problem of distinguishing between monometamorphic cover sequences (of supposed Mesozoic age) and polycyclic basement units, 3) the cooling history of the region based on 40Ar/39Ar age determinations.

We present a new geological map of the region. Detailed mapping indicates the Sesia zone can be divided into three main complexes: 1) a polycyclic basement complex, 2) a monometamorphic cover complex, and 3) a pre-Alpine high- grade basement complex. We subdivide the polycyclic basement complex into three units on the basis of degree of metamorphism. The internal units show HP assemblages only weakly reequilibrated under GS facies conditions. The intermediate units display reequilibration to GS facies conditions with relicts of the HP assemblages. GS facies lithologies dominate the external units, where HP relicts are scattered and rare.

The monometamorphic cover complex crops out between the Gressoney Valley and the Chiussella valley. This complex comprises basic and quartz-rich ribbons, layered on a metric scale. We interpret these rocks as a volcano-sedimentary sequence. The basic rocks show a geochemical within-plate basalt (WPB) signature with tholeiitic affinity. Dolomitic marbles overlie this sequence. Similarities to neighboring sedimentary sequences, whose age is well-constrained by fossil assemblages, allows us to infer an upper Triassic age for the marbles. Mid-ocean ridge (MORB) metabasalts and associated meta-sediments commonly punctuate these marbles, and therefore are probably also of upper Triassic to lower Jurassic age. A calcschist sequence exists in contact with both the metabasalts and dolomitic marbles. These calcschist units contain olistholiths of the rock-types described above and are characterized by high-manganese content typical of near-ridge sediments. We propose, then, that the calcschists were deposited soon after the other units of the monometamorphic cover complex. Decametric- scale blastomylonitic gabbroic bodies appear dispersed throughout the entire monometamorphic cover complex. These gabbros are magnesium-rich, tholeiitic, and geochemically identical to other Austroalpine gabbros emplaced at the crust-mantle boundary. The gabbros described in this study are not found in association with typical oceanic crustal material (such as serpentinites) and are probably related to the other Austroalpine gabbros. Lower Permian U/Pb age determinations support this hypothesis (Bussy et al., in prep.).

We use mineral chemistry and 40Ar/39Ar ages to define the P- T-t (pressure-temperature-time) path followed by the monometamorphic cover rocks. Actinolites record a prograde metamorphic path; their compositions indicate temperature conditions between 300 to 500¡C and pressure conditions between 4 and 7 Kbars. Cation-exchange equilibria, which are reached in the garnet-pyroxene system at 550¡C, reflect metamorphic peak conditions. Cation-exchange equilibria are reached in the garnet-amphibole system at 450¡C. Omphacites show a decreasing jadeite component from the core to the rim. We link the latter equilibria and the omphacite zonation to a retrograde pressure path. Stable isotope thermometry applied to eclogite mineral separates (quartz- garnet-rutile) yields temperatures of 570¡C, consistent with cation exchange thermometers. Stable isotope thermometry applied to retrograde mineral separates (qzartz-albite- omphacite) yields temperatures of 420¡C, also consistent with the garnet-amphibole geothermometer. Stable isotope Deuterium investigations of phengitic micas indicate a fluid source linked to deep subduction of the oceanic crust beneath the continental crust. All of the basement and cover units, with the exception of the pre-Alpine high-grade basement complex, reached isotopic equilibrium.

We present incrementally heated 40Ar/39Ar age spectra from 29 phengites both in the internal HP basement and cover units and the external GS basement units. Cooling ages group at 100-60 Ma for the well-preserved HP units and at 45-50 Ma for the GS units. Ages from the internal units between 70-80 Ma are based on isochrons and reliable plateaux. Our field and isotopic data, combined with published data, support different cooling histories prior to 35 Ma for the internal and external units. These two units follow a common P-T-t path subsequent to 35 Ma.