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Formation and exhumation mechanisms of high-grade rocks: Sagduction and Subduction processes during the Archean

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The interpretation of high-grade rocks in the Archean is controversial. Mid- to high-pressure assemblages are commonly interpreted in terms of plate tectonic processes including subduction. In the Archean however, mid- to high-pressure assemblages could have been also produced during the sagduction of greenstone covers into their crustal basement. Often put in opposition, sagduction and subduction are not incompatible processes. In order to better documents the P-T-t signatures of both processes we are conducting a comparative study - structural, metamorphic and numerical - of supposedly subduction-related metamorphic rocks described in $\sim$3.5-3.2 Ga old Barberton greenstones (Kaapvaal Craton, South Africa) (*Moyen et al., 2006*), and supposedly sagduction-related high-grade rocks in the 3.5-3.2 Ga old East Pilbara Craton (Western Australia) (*Delor et al., 1991*). Interestingly, these two terranes display dome-and-keel structure in which narrow belts of greenstone (ultramafic and mafic metabasalts) and overlying sedimentary rocks occur in association with broad TTG (trondhjemite-tonalite-granodiorite) granitoids.

We present here preliminary results from fieldwork, metamorphic investigations and numerical experiments. Petrological analyses have been conducted on metabasalts and metasediments in enclaves in migmatitic and granitic rocks, both inside and outside granitic domes.

We sampled high-grade mafic rocks in enclaves within the NNE trending steeply deeping migmatitic Inyoni shear zone located between the 3.45 Ga Stolzburg pluton and the 3.2 Ga Badplass gneisses in the southern Barberton terrane (*Moyen et al., 2006*). Preliminary P-T estimations have been performed with multi-equilibrium approach using Thermocalc and with thermodynamic modeling using Perple_X on garnet-amphibole-clinopyroxene-epidote-plagioclase assemblage reveals pressures of 12-14 kbar at temperatures of 600-650ºC for the metamorphic peak. Maximum temperature is reached at the beginning of exhumation, synchronous with the appearance of migmatitic rocks.

These results confirm those reported in *Moyen et al., 2006* (12-15 kbar, 600-650˚C). In the Pilbara craton, we sampled a large garnet-bearing layered metapelite outcrop in enclave in a granitic complex. The thermobarometric approach mentioned above was applied to garnet-biotite-muscovite-amphibole-feldspar-aluminosilicate assemblages and reveal pressures of 6-9 kbar at temperatures of 650-800˚C for the metamorphic peak. *Delor et al., 1991* have found similar results (6-7 kbar, $<$ 700˚C).

Moyen et al., 2006 uses apparent geothermal gradient to argue that the subduction was operational by 3.23 Ga. However, based on this apparent geothermal gradient, high-grade rocks from Barberton and Pilbara could share the same tectonic history: *Delor et al., 1991* concludes that, for the Pilbara, the burial metamorphism is not the only process capable of generating such pressures and temperatures.

To interpret metamorphic data in terms of tectonic processes we are performing 2D coupled thermo-mechanical experiments to constraint the range of PTt paths followed by high-grade rocks in the context of subduction and sagduction. These PTt paths will be compared with field, thermobarometric and geochronologic data.