Indentation, melt migration and deformation progression in UHT Chinese Altai orogeny: insight from analogue modelling

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Résumé

The East Junggar block (EJB) and the Chinese Altai Accretionary Wedge (CAAW) Permian collisional deformation is manifested by: 1) underthrusting of the EJB beneath the CAAW resulting in imbrication and upright south-verging folding of low grade foot-wall Carboniferous sequences, and 2) granulite facies metamorphism associated to extensive melting of Ordovician to Devonian sequences of the hanging wall CAAW. There, the high grade rocks occur in cores of three crustal scale antiforms which alternate with wide synforms formed by low-grade rocks. Antiform hinges are intruded by pegmatite dyke swarms originally oriented perpendicular to fold axial planes and axes. The monazite U-Pb ages and Ar-Ar dating of pegmatite dykes show decreasing intrusive ages from the EJB-CAAW contact (ca. 300 - 280 Ma) towards the interior of the CAAW (ca. 280 – 260 Ma) alongside with increasing degree of deformation.

In order to understand these features we performed a series of analogue wax-sand box experiments. The wax was preheated from the bottom so that the lower layer was fully molten. The ductile middle part of the experiment was only partially molten, while the sand layer was brittle. The whole system was laterally shortened from one side simulating arrival of a rigid indenter (the EJB). The experiments show progressive detachment folding of the multilayer system (CAAW), with growth and shortening of the first antiform (adjacent to the indenter) while the second antiform was progressively filled with melt expelled from the first one. The locking of the first antiform was associated with rapid amplification of the second one from which the melt was further expelled away. When the two antiforms became locked, the residual melt further migrated into core of the third antiform, which was slowly

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amplified and where the melt was finally freezing.
This experimental study shows progression of deformation together with migration of magma towards the interior of the orogen. It successfully simulates time-scales of deformation which corresponds to the EJB-CAAW collision. Such a behavior is in contradiction with popular channel flow model which shows an opposite melt movement and strain progression and thus may represent another orogenic end-member.

Mots-Clés: Indentation, melt migration, starin migration, analogue modelling