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Timescales for contrasting types of metamorphism related to subduction: insight from numerical modeling

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Contrasting types of metamorphism within one metamorphic complex or neighboring complexes related to subduction have been located. The origin of this complexity is not entirely understood. Based on numerical experiments we propose an explanation for the appearance of metamorphic rocks of various burial/exhumation histories within the same subduction-related tectono-metamorphic province.

We have observed that coupling forces between the slab and overriding plate may lead to fore-arc compression, consequently oceanic crust is bent and narrow deep basin is formed. Burial of oceanic crust may reach the depth of 55-60 km. The overall time of burial process is around 50 Myr. Over time, there is a transition from a compressional to an extensional regime. This transition forces the fore-arc lithosphere to be dragged to the surface with the restoring force of subduction channel material. The exhumation process takes approximately 14 Myr. The overall time of burial and exhumation (64 Myr) ensure that the oceanic rocks were exposed to higher temperature (up to 500˚C) long enough to obtain medium temperature and high pressure metamorphic changes (HP-MT). Simultaneously to basin burial and exhumation the subduction channel material is subjected to 6 burial-exhumation cycles. The average time of one cycle varies between 9 and 13 Myr: 7-8 Myr of burial and 2-5 Myr of exhumation per one cycle. The maximum depth to which the accretion wedge material is drugged down is 55–65

km and is exposed to the temperature up to 300˚C. This means that the circulating material is changed by high pressure – low temperature metamorphism (HP-LT).

These simultaneous processes lead to occurrence of contrasting HP-MT and HP-LT metamorphic complexes with very different burial/exhumation rates and histories within the same subduction province. In addition, the age of HP-LT metamorphism may vary strongly due to complex circulation and mixing of rocks within accretion wedge and subduction channel.