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Physical controls of magmatic productivity at Pacific-type convergent margins: Numerical modelling

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We use a coupled petrological-thermomechanical model of subduction with spontaneous slab bending to investigate magmatic productivity at active continental margins. The model is designed to simulate fossil Pacific-type margins which have a well developed accretionary wedge system in the forearc. The degree of plate coupling strongly depends on the plate convergence rate. Delamination of the slab from the overriding plate followed by trench retreat is common for models with a slow convergence rate ($<$5 cm/yr). In contrast, higher convergence rates result in continuous plate coupling. The slab bending curvature increases with the increasing length of subducted plate after initiation of subduction. Periodic variations of slab dip angle with time occur at later stages and become conspicuous with greater depth. These variations are favoured by slower subduction rates and a strong oceanic lithosphere.

Two fundamentally different regimes of melt productivity are obtained in numerical experiments and are consistent with natural observations: (1) During continuous convergence with coupled plates (as in the Late Paleozoic margin of central Chile) melt production is a maximum at the onset of subduction and then decreases rapidly with time due to the steepening of the slab inclination angle, which precludes formation of partially molten mantle wedge plumes. (2) During subduction associated with slab delamination and trench retreat resulting in the formation of a pronounced back arc basin with a spreading centre in the middle (similar to the Mesozoic margin of southernmost Chile) melt production increases with time due to shallowing/stabilization of slab inclination associated with upward asthenospheric mantle flow toward the exten-

sion facilitating propagation of hydrous partially molten plumes from the slab.