Stress-induced magmatism on a flexural plate: correlating temporal-spatial relationships between the Cretaceous Omineca Magmatic Belt and the Central Cretaceous Kimberlite Corridor

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The Cordilleran Orogen of western North American is characterized by the Cretaceous Omineca Magmatic Belt (OMB), a northwest-southeast striking belt of granitoid plutons that extends from Alaska to the continental US. 1000 km to the east of and parallel to the OMB is a 4000 km long, N-S striking, kimberlite magmatic belt called the Central Cretaceous Kimberlite Corridor (CCKC). Kimberlite magmatism in the CCKC was coeval with the termination of OMB magmatism. Cordilleran magmatism, including the OMB, is commonly explained in terms of long-lived east-dipping subduction beneath the west margin of the continent. However, explaining coeval magmatism in the OMB and CCKC by east-dipping subduction is problematic. Here we suggest that the CCKC and OMB magmatism are linked and both products of west-dipping subduction of North American lithosphere beneath the Cordillera. In this model the OMB is a magmatic arc caused by dehydration of the subducting slab and its termination marks slab-breakoff following entry of continental North America into the trench. We propose that the CCKC is formed by extensional stress acting on the lower surface of the continent as it flexes upon entry into the trench. We set up a semi-infinite beam model as an analogue to the flexural plate, analyzing the stress distribution at the lower surface of the elastic portion of the subducting continental plate. We show that the CCKC occurs where the maximum tensile stress developes at the bottom of the flexural plate. The maximum tensile stress at the base of the lower plate relative to the first node (deflection is 0) matches the ~750 km distance between the CCKC and the trench. Our model explains Cretaceous North American kimberlite magmatism as a product of a tensile stress acting on the subducting, lower (flexural) plate of a west-dipping subduction zone.

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