



Exhumation processes and orogenesis through time: insights from PT paths

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Structural and metamorphic signatures of collision zones involving stiff lithospheres with a resistant sub-Moho mantle differ from those of weak lithospheres involving a ductile sub-Moho mantle. Stiff lithospheres favour strain localisation along major shear zones, with subsequent juxtapositions of tectonic units affected by strongly contrasting metamorphic histories. In contrast, weak lithospheres favour distributed deformations. We present field evidence, analogue experiments and numerical models that show that PT paths record first-order information including degree of strain localisation, dominant mode of exhumation of deep crustal units, as well as orogen-induced topographies and associated erosion modes. Weak orogenic zones commonly record retrograde PT paths showing a combined decrease in pressure and temperature. PT paths may track geotherms, indicating thermal equilibrium, which suggests slow strain and exhumation rates, and distributed erosion of crustal domains affected by distributed shortening with limited strain localization and topographic gradients. Such paths seem frequent in accretionary orogens commonly observed in Precambrian times. They differ from PT paths that track isothermal decompression reflecting high strain and exhumation rates localized along major shear zones, a feature typical of modern collision belts. Across orogens, collisions between stiff or weak domains are marked by localized or distributed volumes of exhumed deep rocks, respectively.