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Characteristics of the architecture and evolution of fossil accretionary systems in Chile

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Along the Coastal Cordillera of Chile between the latitudes 30° and 55°S fossil accretionary systems have been developed at the passive margin of the microplate “Chilenia” after its collision with the western Gondwana margin. This evolution started in late Palaeozoic times in the north and during Mesozoic times in southern Chile. The areas of fossil accretionary systems in Chile provide an ideal laboratory for the study of deep-seated levels of accretionary systems which are essentially composed of continent-derived metagreywackes with intercalations of 10-15% of disrupted oceanic crust.

Accretion started in central Chile before 320 Ma with frontal accretion within upper levels at 4-6 kbar, 250-300°C under a relatively high geotherm. Chevron folds of bedding planes and reverse faults were formed indicating subhorizontal shortening. Most dehydration at this level already occurred at 230-250°C causing weakening. Subhorizontal flow paths at maximum depth are proved by a near-isobaric prograde PT-path. At the same time, material more deeply subducted into the subduction channel was heated against a still hot mantle wedge at 12-16 kbar, 600-700°C and subsequently cooled at depth during subsequent underplating of material, following an anti-clockwise PT-path. Forced flow is the predominant mass flow process in the subduction channel, but very few material was later incorporated into the accretionary prism itself at higher levels.

At about 310 Ma the accretion mode changed from frontal to basal accretion at 7-10 kbar, 350-400°C. This is due to continuous cooling of the accretionary system with dehydration and, thus, weakening occurring at 280-320°C under a lower geotherm. Deformation after accretion is represented by pronounced flattening which resulted in a penetrative subhorizontal transposition foliation by pressure solution processes. Static recrystallisation outlasted deformation during decompression with slight cooling. Although particle paths are mostly subvertical, they are partly subhorizontal after subduction to maximum depth. Exhumation rates were slow (around 0.5 mm/yr) with erosion as prime exhumation factor. Erosion at an axial rise balanced accretion at depth leading to recycling of material to the trench as well as filling of retrowedge basins. Accretion ended after about 100 million years. Mass flow cycles lasted between 50 and 100 million years.