Tectonic geomorphology: The South-Central Chilean active margin

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Objectives

- Define segments of different tectonic and geomorphic evolution in time and space.
- Quantify process rates to derive a dynamic model of Plio-Pleistocene forearc evolution.
- Reveal the relationships between tectonics and geomorphic response of the landscape.

Geologic and tectonic setting

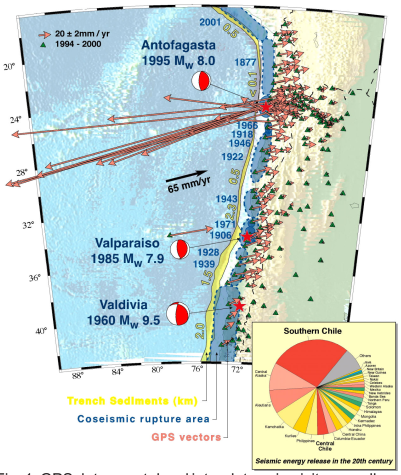


Fig. 1: GPS data, crustal and interplate seismicity as well as historic large magnitude earthquakes document ongoing forearc deformation (mod. after Khazaradze et al., 2003)

Study area (Fig. 1-3)**:**

- Chilean convergent margin
- tectonically active forearc region (Coastal Cordillera)

Basement lithology (Aguirre et al., 1972) (Fig. 4)**:**

- granite-dominated north
  - -» Eastern Series
- schist-dominated south
  - -» Western Series

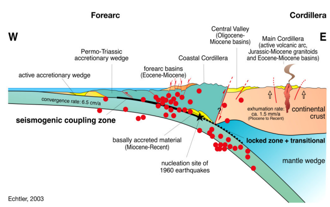


Fig. 2: Schematic profile of the subduction zone: accretion and underplating

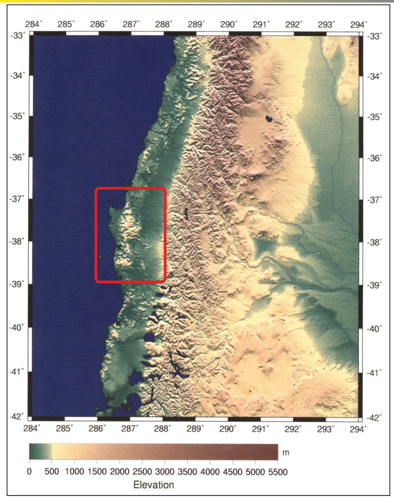


Fig. 3: Topography of the study area

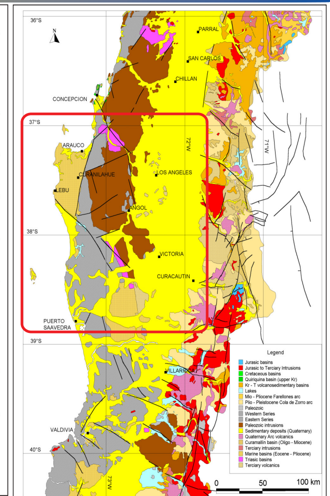
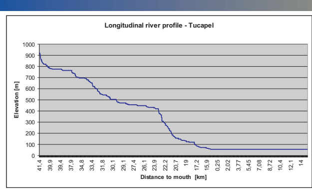


Fig. 4: Geologic map modified after Sernageomin, 1980

Methodology



➚ Fig. 5: Coastal Range river profile (Rehak, 2005)

➘ Fig. 6: Pebble counting on a fluvial terrace

Remote sensing

- digital elevation models
- morphometry
- river profiling (Fig. 5)

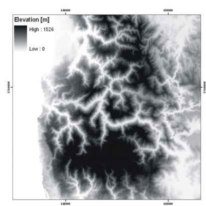
Fig. 7: Quaternary fluvial terrace sequence

Geomorphology

- terrace mapping (Fig. 7)
- drainage basin analysis (Fig. 8)
- surface dating with cosmogenic nuclides (Fig. 9)

Sedimentology

- provenance analysis
  - pebble counting (Fig. 6)
  - sandstone petrography
- palaeocurrent reconstruction



➚ Fig. 8: Fluvial network

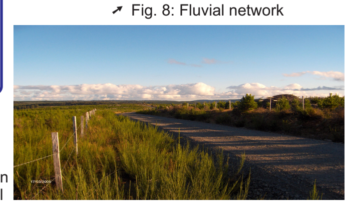


Fig. 9: Erosional surface in the Coastal Range, 800m asl

Preliminary results

Fig. 10: Lower level - Shist conglomerates

- The drainage network is being subjected to a tectonically controlled large-scale reorganisation (wind gaps, drainage reversal, decrease in catchment area).
- These processes are reflected in the sediment record of fluvial terraces along the major stream systems.
- Two terrace levels (Fig. 10 & 11) differ in lithology, clast imbrication and clast alteration, suggesting variations in source area, palaeoflow direction and age, respectively.

Fig. 11: Upper level - Multicoloured Congl.

→ Drainage basin areas have been reduced due to tectonically induced stream capture.

→ Palaeodrainage networks were all sourced in the Main Cordillera or Longitudinal Valley and traversed the Coastal Range.

→ Currently, streams between the rivers Bio-Bio and Imperial appear to be defeated by tectonic deformation.

Conclusions

• The uppermost terrace levels preserved in the Coastal Range were generated in Plio-Pleistocene time and record an undisturbed drainage network linking the volcanic arc with the Pacific Ocean.

• Drainage reversals, tilted terrace systems and major changes in provenance as well as fluvial networks during the Quaternary document fluvial defeat by ongoing deformation.

Bibliography: Aguirre Le-Bert, L, Hervé, A.F. & Godoy, P.B.E. (1972): Distribution of metamorphic facies in Chile - an outline. Krystallinikum, Vol. 7. Echtler, H. (2003): pers. Mitt. Khazaradze, G. & Klotz, J. (2003): Short- and long-term effects of GPS measured crustal deformation rates along the south central Andes. JGR, Vol. 108, B6. Rehak, K. (2005): Morphometrische Analyse eines aktiven Kontinentalrandes - Cordillera de Nahuelbuta (Chile). Arbeitsberichte. Heft 107. Geographisches Institut der Humboldt-Universität zu Berlin.

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