



## **Fluvio-geomorphic and geochemical effects of lithospheric flexure in the overfilled east-Andean foreland**

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The topographic mass of mountain belts constitutes a local load on the Earth's lithosphere, which causes flexure. This is expressed in the formation of foredeeps fringed by a forebulge with minor uplift and a very shallow backbulge basin. Foredeeps can subside rapidly, aided by the load of accumulating sediments, to attain depths of many kilometres. In contrast, forebulges have slower uplift rates and amplitudes of several hundred metres at most. Where sediment supply to the foreland is limited, the foredeep remains underfilled and the forebulge may form a notable topographic high. Overfilling of the foreland results in the formation of a sediment apron covering all flexural features. In the absence of seismic reflection data, we have struggled to delimit flexural features in such settings, because the local elastic thickness of the lithosphere is hard to constrain. However, ongoing subsidence and uplift in flexural forelands should influence the drainage system conveying water and sediment from the mountain hinterland. In theory, a river draining across a flexural foreland should elevate its bed by sediment deposition in the foredeep, and incise the forebulge to maintain grade. We hypothesize that this gives rise to detectable fluvio-geomorphic features, including channel superelevation and inset channel belts, and that the associated local relief causes dispersive seepage from the channel in the foredeep and backbulge basin and drainage of groundwater from the forebulge into the channel. As a result the forebulge has the potential to contribute significantly to the weathering flux from combined mountain-foreland catchments. We test this hypothesis in the East Andean Chaco foreland, where lithospheric flexure dominates geodynamics. We focus on the Rio Bermejo in Argentina, which drains across the foreland in a single channel without significant tributaries and distributaries over a distance of 700 km east of the Andean mountain front, building a narrow fluvial megafan. This river uniquely allows us to avoid complications arising from the confluence of water and sediment in dendritic drainage systems, and to isolate the effects flexure. We find a fluvio-geomorphic segmentation of the Rio Bermejo, expressed in the plan-view channel pattern and lateral mobility of the river, but also in its superelevation and incision. Seepage loss, likely from superelevated channel segments, and not evapotranspiration, results in a 30% loss of river discharge between the mountain front and the distal end of the megafan. In contrast, groundwater drains from the forebulge into the incised channel, causing a step change in the concentrations of dissolved major elements in the river. Thus, the remarkably flat Chaco plains of the East Andean foreland bear distinct fluvio-geomorphic and geochemical marks of lithospheric flexure.