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Microseismic reflection imaging of the Precordillera crust, forearc of the North-Chilean subduction

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With the motivation to study large-scale fault zones in the Central Andean forearc system, a dense seismological array was deployed around the West Fissure Fault System (Precordillera, North Chile, around 21°S 69°W). The observed shallow microseismicity shows a particular distribution characterized by a sharp westward dipping lower seismicity limit at around 10-25 km depth. This boundary dips in sense opposite to the North-Chilean subduction zone and appears to be closely linked to the shallow rheologic and/or tectonic structure of the forearc. With the aim to image the structure of the upper Precordillera crust (depth < 35 km), we processed the P-wave and S-wave coda of several hundred microseismic recordings using signal processing and imaging techniques adapted from active seismic-reflection surveying. Key data processing steps involved precise arrival time picking and hypocenter localization, removing signal variations due to varying source radiation patterns, and identification and separation of reflections from coherent noise. Then, we mapped the processed waveform amplitudes to their reflection-point locations in the subsurface. The resultant microseismic-reflection images reveal a 15-degree westward dipping reflector in around 5-25 km depth that largely coincides with the distinct lower seismicity boundary. To our knowledge, these sections with horizontal extensions of around 50 km represent the first crustal-scale seismic-reflection images derived from passive seismic data.