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New features of the crustal structure of the southwestern Alps unveiled by the CIFALPS experiment

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Seismic tomography data on the lithospheric structure of the southwestern Alps (France-Italy) are surprisingly scarce, in strong contrast with structural geology and petrology data. Most crustal-scale models of the western Alps rely on the results of the ECORS-CROP controlled-source seismic experiments, which were located in the northernmost past of the French-Italian Alps. Local earthquake tomography and gravity modelling were later used to constrain the only crustal-scale model proposed for the southwestern Alps (Lardeaux et al., 2006). The geometry of the crust-mantle boundary was mostly extrapolated from the ECORS-CROP line recorded 150 km to the north. Moreover, the European Moho beneath the internal zone was not detected along the normal-incidence ECORS-CROP seismic line, and it could only be traced on wide-angle reflection data. To get direct constraints on the Moho geometry of the southwestern Alps, we initiated the CIFALPS project (China-Italy-France Alps seismic survey), which is based on a temporary network of 55 broadband seismic stations installed for 14 months in 2012-2013. The core of the CIFALPS experiment is a profile of 46 stations with an interstation spacing of 5 to 10 km. The profile trends WSW-ENE from Bollène (lower Rhône valley, France) to the region of Alessandria (Po plain, Italy), crossing the axial part of the range in the Monviso – Dora Maira region. The experiment was designed to optimize the quality of crustal tomography, using mainly receiver functions in a first step. We computed ∼2000 radial receiver functions, which were stacked in a common conversion point (CCP) depth migrated section of the crustal structure. The European Moho is delineated by a strong P-to-S converted phase in the western part of the profile, which attenuates rapidly beneath the Briançonnais zone, and disappears beneath the Lanzo region. It dips eastward from ∼25 km depth beneath the Rhône valley to ∼33 km beneath the Vocotian basin, ∼40 km beneath the Frontal Penninic Thrust and ∼60 km beneath the Lanzo region where it disappears. The converted signal from the European Moho is strongly attenuated beneath the internal zone, as observed in the normal-incidence reflection section of ECORS-CROP. We conclude from this similarity that the European Moho is intrinsically different beneath the internal zone, possibly due to eclogitization. In the eastern part of the profile, the conversion on the Adriatic Moho is strong and very segmented, with vertical steps of a few km. A broad converted phase of negative polarity observed beneath the Dora Maira Massif might correspond to the contact between the lower part of the high-velocity Ivrea body and the European lower crust beneath it. Further work will include testing our interpreted crustal-scale cross-section with gravity modelling.