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Links between fluid circulation and deformation in erosive subduction channels: constraints from

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The late Eocene-middle Miocene erosive plate boundary between the European and Adriatic plates is exhumed in the Northern Apennines of Italy. The fossil fault zone is 500 m-thick and the outcropping portion exposes the first 5 km of its depth extent. At this plate boundary basal and frontal tectonic erosion incorporated unlithified, fluid-rich sediments into the fault zone. The deformation and nature of the material along the plate boundary define a fossil subduction channel. Here we couple a detailed structural analysis of the Apennine subduction channel, focusing in particular on calcite veins, with a stable isotope analysis to characterize the fluid regime along an active subduction channel.

The 13C and 18O composition of calcite vein and host rock samples within the fault zone indicates that there is a deep metamorphic source of fluids migrating upwards along the subduction channel, in addition to locally derived fluid components. Dewatering of subducting turbidites only contributes significantly in the shallowest part of the channel. Structural observations indicate fluid flow along and across the subduction channel. At deep levels, fluid flow is associated with discrete deformation events on shear faults offset by dilational jogs filled with implosion breccias. At intermediate levels, deformation is still cyclic and associated with repeated crack-and-seal events. At the shallowest levels, deformation occurred while portions of the subducting material were still unlithified. Here the deformation is quasi-continuous without associated vein development. Both isotope and structural analyses indicate that this erosive subduction channel behaved as a weak fault with a vertical maximum principal stress.