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Structure and texture of the upper mantle beneath Northern Apennines: evidence from quasi-Love waves.

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Seismic wavespeed in the upper mantle is commonly found to be directionally dependent (anisotropic). This anisotropy, especially beneath the lithosphere, is generally thought to reflect the coherent deformation of the olivine-rich rocks of the upper mantle. While considerable variation has emerged recently in how anisotropy is manifested in the deformation of large rock volumes, such deformation remains the most likely causative factor in the mantle. Anisotropy is detected most confidently by seismic phenomena that are especially sensitive to it, i.e. which are generated most plausibly in settings that involve anisotropy. A Love-to-Rayleigh converted surface wave, a.k.a. quasi-Love wave, is an example of such anisotropy-dependent seismic phase. Quasi-Love waves originate most readily from lateral gradients in seismic anisotropy structure. Observations of this wave are most commonly done at relatively long (50 - 100 s) periods where other perturbations are easier to discount. We observed quasi-Love waves within the temporary seismic array deployed in Northern Italy in the framework of the RETREAT project. The most spectacular observation comes from the Mw˜9.3 Sumatra-Andaman earthquake of 12/26/04. Record sections constructed across the Apennines show clear distortions of the Love wavefield. In the time window of the Love wave a vertically polarized phase (a diagnostic of quasi-Love phase) appears on records from all sites in Tuscany, west of the Apennines, but not at sites east of the orogen. The distribution of observations and non-observations of the quasi-Love wave is identical in records from the subsequent 03/28/05 Mw˜8.7 North Sumatra earthquake. Given the raypaths' geometry (arriving from the East) observation of quasi-Love waves only west of the Apennines' crest suggests an anisotropic gradient that follows the trend of the Apennines. Spectral content of quasi-Love waves (clearly seen at periods as short as 50 sec) suggests relatively shallow depth of the implied

gradient in seismic anisotropy of the upper mantle. We expect to refine the definition of its locus by examining records of great Sumatra earthquakes from numerous sites of the Italian National Centralized Seismic Network. We also find likely quasi-Love phases in records from a number of other earthquakes. Comparing the pattern of quasi-Love wave excitation in Northern Apennines with other geophysical constraints (tomographic images, observations of teleseismic shear wave splitting) we find good support for the notion of the subhorizontal orogen-parallel mantle flow east of the Apennines. A flow with this geometry is expected in a scenario where Adriatic lithosphere subducts beneath Italy and experiences significant eastward rollback.