Mantle anisotropy beneath the Japanese islands

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We made a detailed mapping of shear-wave splitting parameters of multiple ScS phases for the whole Japanese islands and their back-arc region. A set of multiple ScS phases (ScS, sScS, ScS2 and sScS2) has a mutually common source-receiver pair among the three nearby deep shocks and more than 500 stations of the Hi-net tiltmeter network. The multiplicity of the ScS phases, the limited number of earthquakes and an unprecedented number of stations made it possible to resolve mantle anisotropy into the three parts, anisotropy on the source side, receiver side and in between. The anisotropy on the source side is one in the upper mantle above the Wadati-Benioff zone at great depths far away from the trench, where vertically propagating shear wave is polarized with the fast direction roughly parallel to the dip direction of the Wadati-Beioff zone. The anisotropy on the receiver side is one in the wedge mantle just beneath the Japanese islands, where two types of anisotropy systems are dominant. On the Pacific side of the volcanic front vertically propagating shear wave is polarized with the fast direction approximately parallel to the trench, whereas it is polarized with the fast direction approximately parallel to the plate convergence direction on the marginal sea side of the volcanic front. The along-ray-path mantle excluding the upper mantle on the source side and the wedge mantle on the receiver side is uniformly anisotropic in a sense that vertically propagating shear wave is polarized with the NNW fast direction. There are some indications that this anisotropy does not extend substantially below the uppermost lower mantle. The NNW fast direction is not parallel to the present motion of the Pacific plate but to its ancient (before 43 Ma) motion. These results should be useful in imaging the mantle flow pattern under the typical subduction zone and in understanding the deformation mechanisms associated with it.