Notion of anisotropy: anisotropic media and anisomeric media.

Osamu Nishizawa[1]; Tatsuhiko Saito[1]

[1] AIST

When we consider seismic wave propagation in the earth's interior, we sometimes consider anisotropy. The common idea is that we regard the medium as an equivalent homogeneous medium that contains preferred orientation of the anisotropic minerals and thin cracks or fractures, provided that the wavelength is much larger than the scale lengths of heterogeneities. The elastic anisotropy of the medium can be described by elastic stiffness constants, and velocity anisotropy is calculated from the elastic stiffness constants and the density.

When the scale length of heterogeneity is comparable to the seismic wavelength, diffraction and scattering appears and modify waveforms. Medium may have different scale lengths in different directions. This difference results in the difference in wave propagation in different directions. In such a case, we recognize anisotropy of seismic waves in travel time and particle motions of S wave. In the second case, anisotropy in travel time and waveform depends on the frequency of seismic wave. Anisotropy of the medium is not uniquely determined but it is described statistically. This medium is called anisomeric medium. Here we will discuss seismic wave propagation in the two media.

In the second case, if the medium can be regarded as random heterogeneous medium, we describe the medium by an auto-correlation function of velocity or density distribution in space (or spectral density functions). When the scale-length parameters of the random medium are different in directions, we can describe the heterogeneity as a function of direction.

So far, people interpret the anisotropic characters of the earth's interior by assuming equivalent homogeneous anisotropic media. However, if we consider the large-scale heterogeneities that are comparable to the seismic wavelength, the earth's interior is anisomeric rather than the equivalent homogeneous anisotropic media.

There are some studies about seismic wave propagation in anisomeric media. Fukushima et al (2003) studied fluctuation of particle velocity in S-wave propagating through random anisomeric media by laboratory experiments. Saito (2005, 2006) studied the directional changes of the average velocity and envelope of P-wave in anisomeric media. Kawahara's study (Kawahara, 1992, 2004) is also based on the idea of anisomeric media because he studied velocity and attenuation in crack-containing media statistically.

Here, we review those studies and discuss about future studies on anisotropic media and anisomeric media.