We present a method to obtain spatial distributions of seismic anisotropy associated with regional stress and local faulting in the crust from wide-angle seismic data. The method contains three steps. The first step consists of obtaining radial- and transverse-component seismic sections using a pre-stack depth migration algorithm from the S-wave velocity model determined by conventional interpretation of picked intra-crustal seismic events. In the second step, we compute time delays between split shear-waves and polarizations of fast split shear-waves by minimizing the transverse-component seismic energy. The time delay and polarization in each layer are derived using a layer-stripping method. The final step is to estimate the average splitting parameters along the whole profile. Thus, the average time delay and polarization can be regarded as caused by the effects owing to regional structure and stress fields, whereas the residual values of the splitting parameters are considered to be related to local structures and local faulting. Our method allows us to construct multi-layer anisotropic images, which may later be interpreted in terms of intra-layer coupling/decoupling or deformation. We present results from a set of three-component seismic data acquired by a controlled source experiment in the southeast region of China. The results demonstrate that the average polarizations and time delays are consistent with the direction and strength of the stress field, and their lateral variations related to local anisotropy match the spatial distribution of surface faulting crossing the acquisition seismic profile.