

Interpretation of seismic waveform at regional distance for determining focal depth: a case study in Sulawesi Island, Indonesia

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Sulawesi Island, one of the five largest islands in Indonesia, has high seismic activities due to complex tectonic structures related to some active faults (e.g., Palu Koro, Matano and Hamilton faults) and subduction zones. Reliable focal depths of crustal earthquakes are necessary to understand seismotectonics of the crustal layer in Sulawesi Island and its vicinity. However, due to the sparse seismic network, direct P- and S-wave arrival times are not precise to estimate the focal depths in the study area. To obtain more precise focal depths, this study analyzed waveforms of some swarm earthquakes in four areas of interest in Sulawesi Island and considered the effect of sedimentary layer on seismic wave propagation which yields more reflected phases in seismograms. We have selected swarm crustal earthquakes with 5-30 km focal depth range and ≤ 3.5 deg for station-event distance. In this study, we focused on preliminary depth phases by comparing synthetic and observed seismograms. We calculated the envelope of the seismograms in order to find different peaks of reflected phases clearly. Synthetic seismograms were generated using the reflectivity method with crustal velocity model derived from CRUST 1.0 and IASP 91 and different thickness of sedimentary layers. By the comparison, we could estimate possible pairs of focal depth for crustal earthquakes and apparent thickness of sedimentary layer along the path from each earthquake. Our study showed that the existence of ocean basins and sedimentary layer led to more complex seismograms in the study area. Therefore, we need to consider the waveform complexity for focal depth determination.

Keywords: Crustal earthquakes, Sulawesi Island, Reflected phases, Synthetic seismograms