Detection of Deformation Signals at Mud Volcanoes in Semau Island, Indonesia

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Mud volcanoes are associated with fluid and solid material vertical extrusion from its source layer (mud reservoir). The size and shape of the mud volcanoes throughout the world are diverse. Furthermore, the reason behind this event is difference in each region but predominantly occurred at convergent plate margins. To date, the most mud extrusion known is in the Mediterranian Sea and Tethyan belt (including Azerbaijan, south Greece, Iran, and Turkmenistan).

Semau Island, located in Timor area of Indonesia, is one of the islands where the northern margin of Australian continental plate meets Banda sea plate. Previous geologic map identified Semau island hosted six mud volcanoes with no description in its size [Barber, et al. 1986], and some of them erupt only mud, whereas others produce mud with an admixture of liquid hydrocarbons [Kholodov. 2002].

In order to detect any possible deformation signals in the mud volcanoes in this region, we applied InSAR method. Twenty four (24) ascending images and ten (10) descending images of ALOS/PALSAR data spanning from 2006 to 2011 were acquired. Because our research area is not covered by single observation image, we concatenate the consecutive frame number. To enhance the processing step in GAMMA software, the oceanic areas and some part of other islands that not our interest were cropped to focus on Semau Island. Interferograms of ALOS/PALSAR dataset were consist of eleven (11) ascending pairs and four (4) descending pairs. Then, using AW3D30 DEM data we tried to remove topographic fringe. During the processing, images were multi-looked in range and azimuth by 2 and 6 respectively. While the oversampling in the azimuth direction can be avoided due to the effect of azimuth slope is limited, range oversampling by a factor of two is needed for good quality of interferogram. This procedure is to avoid uncorrelated contributions that arise in the spectral cross-correlation from interferogram generation. Finally, we applied low order polynomial to mitigate the effects of long wavelength phase trends in our interferograms.

The deformation signal is hardly detected in the majority of the data pairs, due to the unwrapping errors in some pairs and also probably due to the small size of mud volcanoes. Despite low coherence in the possible mud extrusion source, in two image pairs, we detected the possible signal from the mud volcano area that is identical to the location described from the previous geologic map. However, since the geologic map from the previous study was derived from aerial photograph interpretation and the signal detection is in slope area, further research is needed to confirm if it is related to active mud volcanism or simply a landslide signal.

Keywords: Mud volcanoes, InSAR, Landslide

