**Document S2: (a) Review of earlier studies on experimental deformation of granular foam material. (b) Differences in deformation of granular foam material and clay particles in mud.**

1. **Earlier studies on deformation of granular foam material**

Performing deformation experiments on foam material Elliott et al., 2002 stated that the initial stages of the compression (up to 4% strain) are taken up by small amounts of bending in struts that are longer than the average, and which are also inclined to the compression direction. At around 10% and 23% strain, the deformation process takes place by more severe bending of the longer struts. Above 40% strain, the cell collapse becomes more general throughout the structure. However, by 63% strain, the struts begin to impinge in each other. Zhou et al., 2004 studied plastic deformation of the cell wall of struts by experimental deformation on foam material. They observed the concentration of dislocation slip band on the struts occurred where the two struts were connected. At the same strain, some struts developed plastic deformation slip bands whereas others remained undeformed. However, with increasing stress more struts were found to contain slip bands. Two possible plastic deformation modes that lead to the collapse of the structure of aluminum-plastic foams are plastic buckling and plastic bending. If the long struts are ‘‘ideally’’ parallel to the loading axis, then plastic buckling becomes the prominent deformation mode. If there is an angle effect between the loading axis and long struts then plastic bending becomes the dominant mode of deformation mechanism. According to Samsudin et al., 2017 bending is primarily observed at lower strain (i.e. <15%). However, at higher strain, the deformation of cells occurred through severe bending of struts and elastic buckling. According to Zakaria et al., 2018 localized bending of cell walls was observed initially at 4% of strain. However, at higher strain >20% both bending and buckling of the cell wall were observed which further causes cell collapse. The larger cells act as the stress concentration point, hence, larger cells are found to be more susceptible to collapse compare to the smaller cell. At higher stain buckling of the individual larger cells gave rise to the development of shear bands along the transverse direction to the applied compression.

1. **Differences with the compaction of clay**

Although the granular foam material and muds both exhibit similar deformation microstructure i.e. bending, there are also several differences. Firstly, Zakaria et al., 2018 stated that the larger cells in granular foam material act as the zone of heterogeneous strain localization and further take part in developing the shear band. However, in Sumatra mudstone samples, we observed that all larger silt boundary pores are not acting as the zone of strain localization at the same point of time, rather we observed the larger silt boundary adjacent pores which are on the force chain of load exhibit the evidence of strain localization by bending of clay and subsequent collapse. Moreover, we did not find any evidence for the development of shear bands associated with larger silt boundary pores in Sumatra muds. Secondly, in the case of foam structure, the contact between two struts was fixed, hence, during deformation, the bending of a strut in the structure can cause significant distortion to the surrounding cells. However, in the case of mud samples, clay particles are attached with other particles by friction force, and they are not fixed. Hence, during deformation individual clay particles in the mudstone can move without disturbing surrounding clay particles if they lose friction. Thirdly, for the deformation of foam structure, the authors did not observe and mention anything about the fracturing of the struts. However, for Sumatra mud samples we observed fracturing of the bent clay particles was very much associated with the reduction of larger silt boundary adjacent pores.