Supporting information

Influence of clay-rich sediments on methane hydrate formation: impacts on the kinetic behavior and gas storage capacity

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This file includes:

1- **Details on the aluminium cell and sediment core preparation**

2- **Procedure for determining the porosities and water saturations of sand/clay mixtures**

1. Details on the aluminium cell and sediment core preparation

The cores were prepared in cylindrical aluminum cells that are 14 cm high, with an internal diameter (ID) of 5.6 cm. Its lids, located at the two ends, are perforated to allow the injection of gas and water (Fig. 1). In addition, two 6 mm-thick porous stones, in contact with the lids, are used to promote fluid distribution homogeneity throughout the matrix. One porous stone is thus placed at the bottom of the cell, which is then filled with the sample, making sure to leave enough space to place the second stone and close the cell. It can therefore be considered that the matrix is unconsolidated and subjected to very low or no effective stress (self-weight). The aluminum cell filled and closed is inserted into the high-pressure cell, which is then closed by the flange provided for this purpose.

Fig. S1. Photographic images of the aluminium cell used for the sediment cores preparation

2. Procedure for determining the porosities and water saturations of sand/clay mixtures

Pure sand and clay-rich matrices used in this study do not have the same density and porosity. Therefore, we calculate the water saturation of the mixtures sand/clay-rich matrix after water injection in the high-pressure cell filled with the matrix. For that, we estimated the porosity (n) using geometric soils parameters (1) :

- The void ratio

$$e = \frac{n}{1-n} \quad (1)$$

- The water saturation (%)

$$S_w = \frac{V_w}{V_V} \quad (2)$$

- The water content (%)

$$\omega = \frac{m_w}{m_m} \quad (3)$$

- The relationship between those parameters is :

$$e \times S_w = G_S \times \omega \quad (4)$$

The combination of Eq. 1 and 4 allows inferring the porosity (n) using the Eq. 5:

$$n = \frac{\omega}{\omega + \frac{1}{G_S}} \qquad \text{for } S_w = 100\% \quad (5)$$

Where V_V is the volume of voids, V_W is the volume of water; m_w is the water mass, m_m is the sediment of the dry matrix. G_S (2.66) is the specific gravity of soil solids (1).

The water content ω corresponding to a water saturation of 100% has been obtained as follow: water was added to a beaker containing an amount of the sand/clay mixture until a significant layer of water could be seen above the matrix. The beaker was then covered with plastic and left for 24 hours so that all the pores of the matrix were filled by the water. As soon as there was no change in the water layer above the matrix, the excess water was removed. A sample of the wetted matrix was collected, weighed and placed in the oven for 24 hours. The masses difference between the wet sample and the dry one is used to calculate the water content of the matrix using Eq.3.

References

1. B. M. Das, *Advanced soil mechanics* (Taylor & Francis, London; New York, 2008).