Modeling methane bubble growth in muddy aquatic sediments: Numerical and analytical modeling

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Bubble Shape and Size

Shallow gassy sediments contribue to destabilization of aquatic infrastructure, air pollution, and global warming. A precise shape and size of the buoyant methane bubble in fine-grained muddy aquatic sediments if found by numerical and analytical modeling, their results are in a good agreement. Reaction-transport numerical model has been extended by addition of fracture mechanics component. The buoyant mature bubble is elliptical in its front view and resembles an inverted tear drop in its cross-section (Fig.1), in agreement with field observations and lab experiments [1] [2]. The size and shape of the bubble strongly correlate with sedment fracture toughness.

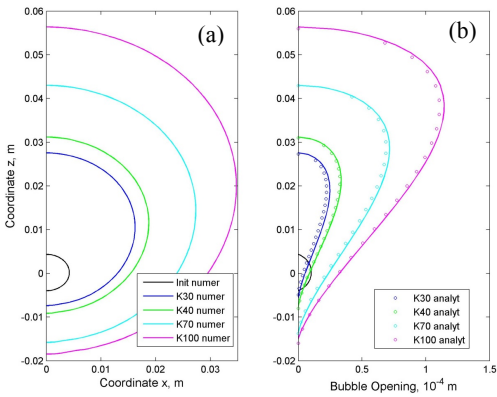

Figure 1: Shape and size of mature bubble modeled numerically and analytically under differrent fracture toughness; (a) front view, (b) cross-section.

Discussion of Results

Bubbles formed in the weaker sediments are smaller and characterized by a larger surface to volume ratio. That induces their faster growth and may lead to their faster dissolution below the sediment-water interface, and even prevent their release to the water column and to the atmosphere. Modeled bubbles characteristics are important for the acoustic applications.

[1] Anderson *et al*. (1998) *Contin.Shelf Res*. **18**, 1807-1838. [2] Boudreau *et al*. (2005) *Geology* **33**, 517-520.