Contribution ID: **21** Type: **Poster Presentation**

Acoustic Properties of Hydrate-Bearing Porous Media Based on Electrical-Mechanical-Acoustic Multi-physics-Field Coupling Model

Tuesday, 14 May 2024 09:25 (1h 30m)

There are technical difficulties in accurately controlling and evaluating the micro-distribution mode and saturation of hydrate in physical simulation experiments. Limitations exist in the experimental technologies for investigating acoustic properties of hydrate-bearing sediments and establishing interpretation models of reservoir parameters. The acoustic properties of hydrate-bearing sediments are influenced by hydrate saturation and micro-distribution modes, skeleton particle arrangement and shape significantly. Currently, there is a lack of research work on the influence mechanisms of skeleton particle arrangement and particle shape. Three-dimensional numerical models were established for hydrate-bearing porous media based on digital rock physics technology. For the three kinds of hydrate micro-distribution modes (suspension, contact and cementation), finite-element models were established individually based on the method of electrical-mechanical-acoustic multi-physics-field coupling. The effects of micro-distribution mode and hydrate saturation on sound velocity and attenuation of porous media were examined. The results of sound velocity from the numerical and theoretical models were compared. The influences of skeletal particle arrangement modes and shapes on the sound velocity and attenuation characteristics of sediments under different hydrate micro-distribution modes and saturation conditions were explored, and the mechanisms were discussed. It was demonstrated that: (1) when the hydrate saturation is low, the volumetric proportion of quartz sand particles in the diamond-arrangement model is higher than that in the cubic-arrangement model, thus the sound velocity of the diamond-arrangement model is higher; as the hydrate saturation increases, the difference in the volumetric proportion of hydrates between the two models increases and the volumetric proportion of hydrates in the cubic-arrangement model is higher, consequently the sound velocity growth rate in the diamond-arrangement model is lower; (2) the porosity of the diamond-arrangement model is smaller than that of the cubic-arrangement model, and the energy attenuation during the propagation of sound waves is lower; (3) compared with the spherical-particle model, the elliptical-particle model contains more pores with smaller aspect ratios, resulting in a smaller bulk modulus and lower sound velocity; (4) the ellipsoidal-particle model contains more and smaller pores, which results in lower wave-energy loss than that of the spherical particle model. This study may provide a theoretical support for the data interpretation of seismic exploration and sonic logging for natural gas hydrate reservoirs.

Acceptance of the Terms & Conditions

Click here to agree

Student Awards

I would like to submit this presentation into both awards

Country

China

Porous Media & Biology Focused Abstracts

References

Conference Proceedings

Primary author: Mr WANG, Yunlong (China University of Petroleum (East China))

Co-authors: XING, Lanchang (China University of Petroleum (East China)); Dr WEI, Wei (PetroChina Research Institute of Petroleum Exploration & Development); Mr HAN, Weifeng (PetroChina Research Institute of Petroleum Exploration & Development)

Presenter: XING, Lanchang (China University of Petroleum (East China))

Session Classification: Poster

Track Classification: (MS19) Elastic, electrical, and electrochemical processes and properties in porous media