利用Mogi模型预测盐岩储气库地表沉降

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PREDICTION OF SURFACE SUBSIDENCE ABOVE SALT ROCK GAS STORAGE USING MOGI MODEL

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摘要 盐岩储气库运营期间腔体体积的蠕变收缩是库区地表持续沉降的主要原因。假设盐腔体积收缩的等效弹性变形引发的地表沉降是实际蠕变沉降的一阶近似量，将盐腔转化为相同埋深、相同体积的球形腔体，并受到均匀向内收缩的弹性等效面力作用，将盐岩储气库地表沉降近似为弹性半无限空间内球型空洞受力收缩导致的边界位移问题。在上述弹性模型的基础上，引入火山地震学中用于预测火山喷发区地表变形的Mogi模型，得到库区地面垂直位移和水平位移的弹性解析解。Mogi模型的优势在于可以直接通过盐腔体积收缩量求得储气库地表位移，并与相同条件下的数值模拟沉降结果有着良好的近似效果，表明Mogi模型在储气库地表沉降预测研究中具有一定的可行性，并给出利用Mogi模型研究盐岩储气库地表沉降的研究方向及建议方法。

关键词： 岩石力学   盐岩储气库   地表沉降   Mogi模型   弹性半无限空间   蠕变收缩

Abstract： The main cause of surface subsidence above salt rock gas storage is the creep contraction of salt cavern volume during operation period. Assuming that the surface subsidence caused by equivalent elastic deformation of cavern volume contraction is a first-order approximate quantity of actual subsidence induced by creep contraction，the salt cavern is transformed as the sphere cavern with the same depth and volume，bearing uniform contractive elastic equivalent surface force. Therefore，the subsidence prediction is similar to the problem of boundary deformation of the sphere cavern with shrinkage force in elastic half infinite space. The Mogi model is introduced to get the elastic analytical solution of the surface vertical and horizontal deformations，which is the most successful method to predict the deformation above volcanoes eruption. The subsidence above the salt rock gas storage could be obtained directly with the volume shrinkage，which is the main superiority of Mogi model；and the prediction result has a good approximate effect to the numerical result under the same condition. It indicates that the Mogi model has enough feasibility in salt cavern subsidence prediction. Finally，the direction and recommendation about the further research are given.

Keywords： rock mechanics   salt rock gas storage   surface subsidence   Mogi model   elastic half infinite space   creep contraction

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