地球物理学报 2003 46 (5): 659~666 ISSN: 0001-5733 CN: 11-2074/P

论文

细观非均匀性对岩石破裂过程和微震序列类型影响的数值试验研究

焦明若

1 辽宁省地震局，沈阳 110031 2 东北大学岩石破裂与失稳研究中心，沈阳 110006 3 中国地震局分析预报中心，北京 100036 4 中国科学院研究生院地学教学部，北京 100039

收稿日期 2002-4-28 修回日期 2003-5-8 网络版发布日期 接受日期

摘要 运用岩石破裂过程分析RFPA2D系统，研究了岩石介质细观非均匀性对宏观力学行为的影响和微震序列特征. 通过对不同均质度系数m=1.1，1.5，2，3，5的5个样本进行破裂过程的模拟，发现均质度不同会产生不同地震序列类型，主要有：前震-主震-余震型、主震型和震群型. 此外，对5种不同均质度系数的岩石样本破裂过程的模拟表明，岩石介质的非均匀性不仅对岩样宏观强度和宏观变形非线性行为有显著的影响，而且也显著地影响试样破裂模式. 随着均质度系数的提高，主破裂呈现脆断模式. 同时介质的细观结构随机性，也对试样宏观破裂模式产生重要影响.

关键词 非均匀性 破裂过程 微震序列类型 变形局部化

分类号

DOI:

NUMERICAL TEST OF INFLUENCE OF MESOSCOPIC HETEROGENEITY ON MACROSCOPIC BEHAVIOR OF ROCK FAILURE AND SEISMIC SEQUENCE TYPES

JIAO MINGRUO

1 Liaoning Seismological Bureau, Shenyang 110031, China 2 Center for Rockburst and Induced Seismisity Research, Northeastern University, Shenyang 110006, China 3 Center for Analysis and Prediction, China Seismological Bureau, Beijing 100036, China 4 Graduate School, USTC, Chinese Academy of Sciences, Beijing 100039, China

Received 2002-4-28 Revised 2003-5-8 Online Accepted

Abstract A newly developed numerical method, RFPA2D, used for analysis of rock failure process, is applied to study the influence of mesoscopic heterogeneity on macroscopic behavior of rock failure and seismic sequence types. The failure processes of rock samples with 5 different kinds of heterogeneity are simulated by numerical calculations. The results show that rock failure with different heterogeneities can produce different seismic sequence types, mainly including (1) main shock aftershock type, (2) foreshock main shock aftershock type, and (3)swarm type. Besides, the numerical simulation of rock failure with different heterogeneities shows that the non linear behavior of rock deformation and fracture pattern as well as failure mode are obviously affected by the heterogeneities. With increasing the degree of rock homogeneity, the macroscopic failure process presents brittle behavior markedly. Meanwhile, it is also found that the failure modes of specimensare sensitive to the local variations of the mechanical properti es of specimens with the same mechanical properties including the heterogeneity.

Key words Heterogeneity;;Failure mode;;Seismic sequence type;;Strain localization.

通讯作者:
mrjiao@yahoo.com，cemrjiao@polyu.edu.hk
作者个人主页: 焦明若