冻融循环条件下岩石核磁共振特性的试验研究

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EXPERIMENTAL STUDY OF NMR CHARACTERISTICS IN ROCK UNDER FREEZING AND THAWING CYCLES

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摘要 为研究岩石在冻融循环作用下微观结构的变化特征，选取寒区花岗岩为试样，在冻结温度为－40 ℃，融解温度为20 ℃条件下分别进行0，10，20，30和40次冻融循环试验，并对冻融循环后的岩样进行核磁共振(NMR)测量，得到不同冻融循环次数后岩样的横向弛豫时间T2分布及核磁共振成像图像。结果表明：花岗岩的T2分布主要为3个峰，第一个峰和第二个峰的面积之和占全部峰总面积的98%以上，表明微孔隙占绝大多数；在经历10，20，30和40不同冻融循环次数后，岩石的T2谱面积发生了明显变化，孔隙率分别增大了14.0%，0.9%，16.2%和1.6%。核磁共振图像显示冻融循环后岩样的孔隙空间分布情况。冻融循环条件下岩石核磁共振特征的变化规律，为岩石冻融损伤机制研究提供可靠的试验数据。

关键词： 岩石力学 冻融循环 核磁共振 花岗岩 孔隙度 弛豫时间

Abstract： For knowing the variation characteristic of rock microstructure under freezing and thawing cycles，the experimental study on granite sample is conducted under different freezing and thawing cycles of 0 time，10，20，30 and 40 times with the freezing temperature of －40 ℃ and thawing temperature of 20 ℃. The nuclear magnetic resonance(NMR) is used to test the samples after freezing and thawing cycles；and the crosswise relaxation time T2 distribution and NMR imaging are obtained. The results show that：T2 distribution of granite exhibits three peaks and the subtotal spectrum area between the first peak and second peak occupies more than 98% of the total area，which means the micro pores are in the majority. After different freezing-thawing cycles of 10，20，30 and 40 times，the T2 spectrum area has changed obviously；and the porosity has increased by 14%，0.9%，16.2% and 1.6% respectively. Also，the space distributions of pores have been visually shown by the NMR imaging. The variation law of NMR characteristics in rock under freezing-thawing cycles has provided the reliable experimental results for the research works of rock damage mechanism under freezing and thawing cycles.

Keywords： rock mechanics freezing and thawing cycles nuclear magnetic resonance(NMR granite porosity relaxation time

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