

赵永红,ZIMMERMANMark,KOHLSTEDTDavid. 2013. 大变形橄榄石动态重结晶的实验观测研究. 岩石学报, 29(3): 967-976

大变形橄榄石动态重结晶的实验观测研究

作者

单位

[赵永红](#)

[北京大学地球物理学系,北京 100871;美国明尼苏达大学地质与地球物理系,MN 55455](#)

[ZIMMERMANMark](#)

[美国明尼苏达大学地质与地球物理系,MN 55455](#)

[KOHLSTEDTDavid](#)

[美国明尼苏达大学地质与地球物理系,MN 55455](#)

基金项目: 本文受国家自然科学基金项目(40821062、40874043、41274094)资助.

摘要:

本文利用高温高压大变形扭转实验,对富铁橄榄石大变形情况下的动态重结晶和颗粒尺度变化的特点进行了实验观测分析。富铁橄榄石集合体由纯铁橄榄石 Fa_{100} 和圣卡罗橄榄石 Fa_{10} 混合物经人工合成得到,试件的几何形状为圆柱体,直径9.6mm,高度4.86mm。实验在常角速率条件下进行,温度为1473K,围压为300MPa,剪应力为72~99MPa,剪应变率为 $1.35 \times 10^{-4} \sim 3.11 \times 10^{-4} \text{ s}^{-1}$,累积剪应变为3.98。对变形后样品的微结构进行了光学和扫描电镜的观测分析,得到橄榄石颗粒随应变增加而产生动态重结晶的具体物理图像,由EBSD观测结果给出了晶格取向随外加应变增加而产生的变化过程,利用两种统计方法得到了颗粒尺寸随应变增加而变化的过程,探讨了橄榄石动态重结晶的微观机制。与已有三轴压缩、简单剪切以及圣卡罗橄榄石的扭转变形结果进行了对比分析,同时对实验结果在地球物理方面的应用进行了讨论。

英文摘要:

In this paper torsion experiments on Fe rich olivine aggregates were conducted in a high- pressure and high-temperature gas medium torsion apparatus under anhydrous condition to analyze the grain size changes and dynamic recrystallization under different deformation. The Fe rich aggregates were synthesized from Fa_{100} and Fa_{10} mixture. The geometry of the sample was a cylinder with $\sim 9.6\text{mm}$ in diameter and $\sim 4.86\text{mm}$ in length encapsulated by the Ni sleeve to buffer the oxygen fugacity at olivine stability field. The sample undergoes deformation at constant strain rate by simple shear. A temperature of 1473K and a confining pressure of 300MPa at a constant angular velocity were applied during the torsion experiment. The applied shear strain rate ranged from 1.35×10^{-4} to $3.11 \times 10^{-4} \text{ s}^{-1}$, yielding shear stresses of 72~99MPa supported by the sample and an accumulative shear strain of 3.98 were achieved at the end. Microstructure was analyzed with optical and electron microscopy. A series of parallel sections were examined starting near the outside edge of the cylindrical sample and proceeding to the central section. The Electron Backscatter Diffraction (EBSD) was performed on the central profile to determine the Lattice Preferred Orientation (LPO) changes with different strains. The observation is consistent with the LPO reported by Bystricky *et al.* (2000) for samples of San Carlos Fo_{90} olivine.

关键词: [扭转大变形](#) [橄榄石](#) [动态重结晶](#) [晶格最优取向\(LPO\)](#) [颗粒尺寸](#) [高温高压](#) [实验观测](#)

投稿时间: 2012-02-23 最后修改时间: 2012-06-11

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主办单位: 中国矿物岩石地球化学学会

单位地址: 北京9825信箱/北京朝阳区北土城西路19号

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