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<th>New Experimental Insights into Frictional Behaviour and Acoustic Emission of Locally Sheared Granular Materials: Implications for Landslide Dynamics</th>
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Kyoto University
新实验洞察摩擦行为和局部剪切颗粒材料的声发射：对滑坡动力学的启示

课题名称：新实验洞察摩擦行为和局部剪切颗粒材料的声发射：对滑坡动力学的启示

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研究期间：平成28年 4月 1日 ～ 平成29年 3月 31日

研究场所：Research Center on Landslides, Disaster Prevention Research Institute, Kyoto University

共同研究参加者数：5名(所外1名，所内4名)

大学院生の参加状況：1名（博士1名） 内数

大学院生の参加形態：[Conduct tests, analyze data, summarize results, and write papers for publication]

研究及び教育への波及効果について

理解剪切颗粒材料在剪切中的力学行为一直是一个重要的研究领域。最新的研究表明，在剪切过程中，内部应力的波动可以释放存储的弹性能量。根据研究的目的，我们测量了不同剪切速率下不同粒度颗粒材料的应力波动和声发射（AEs）。实验结果显示，剪切行为受剪切速率和颗粒大小的影响。AEs的主要脉冲与主要的机械失效事件高度相关。AEs的最大绝对幅度通常随着应力下降的增加而增加，且平均发生率随着颗粒尺寸和剪切速率的增加而增加。频带主要集中在kHz范围内，声发射能量的释放随着剪切速率和颗粒尺寸的增加而增加。通过观察时间差，我们发现AE事件发生在机械失效之前。这表明局部的失效可能导致声发射的发生。这些研究结果提供了一种对受应力的颗粒材料的进一步理解，可能对灾害评估和减灾有帮助。
We used cohesionless glass beads to remove particle shape as a variable and isolate the role of particle size, and one intelligent ring shear apparatus (DPRI-5) were employed to meet the demands of a wide range of shear speeds. All dry granular assemblies with uniform particle size ranging from 0.1~5 mm were sheared under the room temperature and humidity. Significantly, for measurements of elastic waves, three high frequency AE transducers were installed near the shear plane, and AE signals were amplified by 40 dB and were digitized with a sampling rate of 1MHz during the shear tests. By employing an additional recording system, the mechanical data and AE data were simultaneously recorded. With the help of Prof. Masahiro Chigira (DPRI, Kyoto University) and Mr. Yasuto Hirata (Graduate School of Science, Kyoto University), post-test SEM analyses were performed. Data were analyzed and discussed among all collaborative members, and more useful discussions were also carried out with Mr. William Schulz (U.S. Geological Survey) and Dr. Mauri McSaveney (GNS Science, New Zealand).

Experimental results show that the mechanical behaviors of shear resistance, sample compaction and slip displacement, and the release of acoustic energy can be affected by both shear rate and particle size. The main AEs are strongly correlated with the global mechanical failure, and the maximum absolute amplitude of AEs generally increases with increase of the magnitude of stress drops. By analyzing the event sequences, it is found that the onset of AEs precedes the beginning of stress drop, which provided more useful information on the failure mechanisms of geologic granular materials. Through this New Exploratory Research Project, we introduced our research results on International Journals and conferences, some relating works have been already published and several other papers are under the processes of preparation.


