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Load-Unload Response Ratio (LURR), Accelerating Moment/Energy Release (AM/ER) and State Vector Saltation as Precursors to Failure of Rock Specimens

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Abstract—In order to verify some precursors such as LURR (Load/Unload Response Ratio) and AER (Accelerating Energy Release) before large earthquakes or macro-fracture in heterogeneous brittle media, four acoustic emission experiments involving large rock specimens under tri-axial stress, have been conducted. The specimens were loaded in two ways: monotonous or cycling. The experimental results confirm that LURR and AER are precursors of macro-fracture in brittle media. A new measure called the state vector has been proposed to describe the damage evolution of loaded rock specimens.

Key words: Acoustic emission, LURR, CPH, AM/ER, state vector, precursor of macro-fracture.

1. Introduction

The CPH (Critical Point Hypothesis) considers earthquake rupture as a critical point (VERE-JONES, 1977; SORNETTE and SORNETTE, 1990; SORNETTE and SAMMIS, 1995; BOWMAN *et al.*, 1998; RUNDLE *et al.*, 1999; JAUME and SYKES, 1999). According to CPH the crust is not in a continuous state of criticality, but repeatedly approaches to and retreats from a critical state. During the establishment of criticality the crust must be characterized by both susceptibility to external factors (WEI *et al.*, 2000; XIA *et al.*, 2002) and strong correlation between its different parts. The former will lead to triggering of earthquakes by tidal stress (GRASSO and SORNETTE, 1998) and consequently anomalously high values of

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