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Experimental study of marl fragmentation

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In Draix marly basin (French Southern Alps), field investigations and experiments have shown that the degradation of marly pebbles by fragmentation and abrasion was one of the processes responsible for the high production of fine sediments during the floods. This degradation is mainly caused by the impact and frictional loading on the stones transported as bedload. A high sediment concentration is often an aggravating factor in torrential floods, this is why a better understanding of its production is needed. The present study was therefore designed to investigate the dynamic rupture by fragmentation of unconfined marly material under impact.

Marls are layered rocks, and their mechanical behaviour is mainly controlled by the presence of small fractures and interfaces planes. The heterogeneous structure of the material makes it difficult to investigate the mechanical properties through single event tests. For that reason, a statistical approach was needed, so a simple unconfined impact test was selected to allow multiple testing.

Impact experiments are performed with marls coming from the river bed. Marly stones are dropped above a hard surface and fragmentation events are recorded. Variables of interest are the mass, the impact velocity, the water saturation, the number of impacts and the initial surface state. The initial surface state is characterized by a semi-quantitative fissuration index, based on the appearance and size of surface fractures on each stone.

Statistical analysis shows that the impact velocity and the initial surface state are the main parameters influencing the fracture. A probability law for the rupture is therefore proposed. On the other hand, the mass, the number of previous impacts and the water saturation do not seem to have a significant influence on the rupture.

The mass of the fragments is also recorded and the empirical mass distribution of fragments is similar to what is found in existing studies about the fragmentation of brittle material.