TECHNIQUES OF SHOCK WAVE EXPERIMENTS AND DETERMINATION OF HUGONIOT DATA OF SOLIDS. K. Thoma, Fraunhofer-Institut für Kurzzeitdynamik (EMI), Ernst-Mach-Institut, Eckerstrasse 4, 79104 Freiburg, Germany, thoma@emi.fhg.de

Introduction: In this paper the current techniques used in laboratory shock wave compression of heterogeneous solids [1] will be reviewed with special emphasis on materials used in industrial applications, and on own work at the EMI [2, 3, 4, 5, 6]. These techniques can be fully applied also to geological materials (minerals and rocks).

Laboratory devices for the generation of shock waves: Two major types of techniques are applied for the generation of shock waves at the laboratory scale (e.g. [1]): (1) Air and light gas gun devices and (2) high-explosive devices. The gas gun techniques comprise a wide range of methods ranging from single stage air guns to two-stage light gas guns. The former cover the lowest range of shock pressure to be achieved in solids whereas with light gas guns shock pressure of up to about 100 GPa can be reached depending on the shock impedance of the target material. High explosive set-ups for the generation of plane shock waves can be used in direct contact with the solid target material or preferably in contact with a flyer plate (plane metal plate) which travels a certain distance before impacting the plane surface of the solid to be studied. Both types of techniques can be used for sample recovery devices which operate according to the principle of the momentum trap method in which a metal container prevents the samples from getting desintegrated and dispersed upon impact. The capabilities of the currently used recovery techniques are reviewed.

Measurements of Hugoniot data of solids: Experimentally measured Hugoniot data are of fundamental importance for the quantitative characterization of the shock wave behavior of solids. The relevant experimental techniques focus on the measurement of velocity parameters (impact velocity of the projectile, shock wave velocity and particle velocity in the target). Using the basic Hugoniot equations and specific equations of state the main thermodynamic parameters such as pressure, volume, internal energy and entropy and consequently shock and post-shock temperatures can be calculated from the experimentally determined velocity parameters. The current state of the art and the future directions in this area will be reviewed.

Specific problems of the shock wave behavior of heterogeneous solids: The application of the described basic experimental techniques and the Hugoniot equation of state data to polyphase solids is not straightforward. The present state of the art is discussed in some detail and with special emphasis on the shock wave behavior of concrete [4, 6] used as a multi-purpose construction material. For this case which appears to be well applicable to geological materials (polycrystalline or polylithic rocks), the combination of shock wave experiments with numerical modeling by computer code calculations [2, 5] will be demonstrated, and it will be shown that this approach leads to significant progress in the understanding of the shock wave propagation in heterogeneous solids.