GABBROIC ANORTHOSITE IMPACT CRATERING TIME DEPENDENT Z FLOW FIELDS FOR TWO DIFFERENT IMPACT ENERGIES, M. G. Austin, J. M. Thomsen, Physics International Co., 2700 Merced St., San Leandro, CA 94577, D. L. Orphal, W. F. Borden, S. A. Larson, Calif. Res. and Techn., Inc., 4049 First St., Suite 135, Livermore, CA 94550, and P. H. Schultz, Lunar & Plan. Inst., 3303 NASA Road 1, Houston, TX 77058.

Two continuum mechanics computer calculations of the impact of a 62 m diameter iron projectile (10^{12} g) into a gabbroic anorthosite target half-space at 5 km/s (GA1) (10^{23} ergs producing a 900 m diameter crater) and at 15.8 km/s (GA2) (10^{24} ergs producing a 2000 m diameter crater) have been analyzed in terms of Maxwell's Z-Model. The method of analysis is that reported by Austin et al. (1) where it was applied to the laboratory-scale impact of an aluminum projectile into plasticene clay at 6 km/s. The principal conclusions of (1) hold here also. The Z-Model provides in many ways a good description and analysis of the cratering flow field. The Z parameter which characterizes the shape of the flow field is time dependent with respect to any fixed flow field center. Time dependence of Z means that the flow occurs along time dependent streamlines.

The Maxwell Z-Model has been previously described in detail (1,2,4,5). An essential observation of the Z-Model is the regular power law decay of the radial component of the flow field particle velocity. In a spherical polar coordinate system centered at a flow field center beneath the point of impact and on the axis of cylindrical symmetry, R is the radial distance from this center to a given point in the cratering flow field and θ is the angle measured from the vertically downward direction. The flow field can be described by:

$$\dot{R}(\theta,t) = \alpha(\theta,t)R^{-Z(\theta,t)}$$

where $\dot{R}$ is the radial component of the flow field velocity, α is a time-dependent coupling term describing the flow field strength, and Z defines the rate of velocity decay with range R. Time from impact is t.

The calculations analyzed here were performed by D.L. Orphal et al.(3) and are referred to here as the GA1 and GA2 calculations. The GA2 calculation is of an impact having 10 times the kinetic energy of the impact in the GA1 calculation. Figures 1 and 2 show average Z values for parts of the cratering flow field between 0 (vertically downward) and 30 and 60 degreees for the GA1 and GA2 calculations respectively. Fewer analyses have been done for the GA2 calculation. An important result is that no matter what fixed flow field center is chosen, Z is time dependent to about the same degree. Another important and unexpected result is that for the same depth flow field center and same portion of the cratering flow field, average Z values are about the same for the two calculations at the same absolute (not scaled) times.

The Z-Model provides a convenient and powerful tool for summarizing some of the features of impact cratering flow fields.

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References-1.) Austin M.G. et al.(1980) Proc. Lunar Planet.Sci.Conf.11th (in press). 2.) Thomsen J.M.et al.(1979)Proc. Lunar Planet.Sci.Conf.10th, p.2741-2756,Pergamon. 3.) Orphal D.L. et al.(1980)Proc. Lunar Planet.Sci. Conf.11th(in press). 4.) Maxwell D.E.(1977)In Imp.and Expl.Cratering(Roddy, Pepin and Merrill)p.1003-1008,Pergamon. 5.) Orphal D.L.(1977) In Imp. and Expl. Cratering,p.907-917,Pergamon.

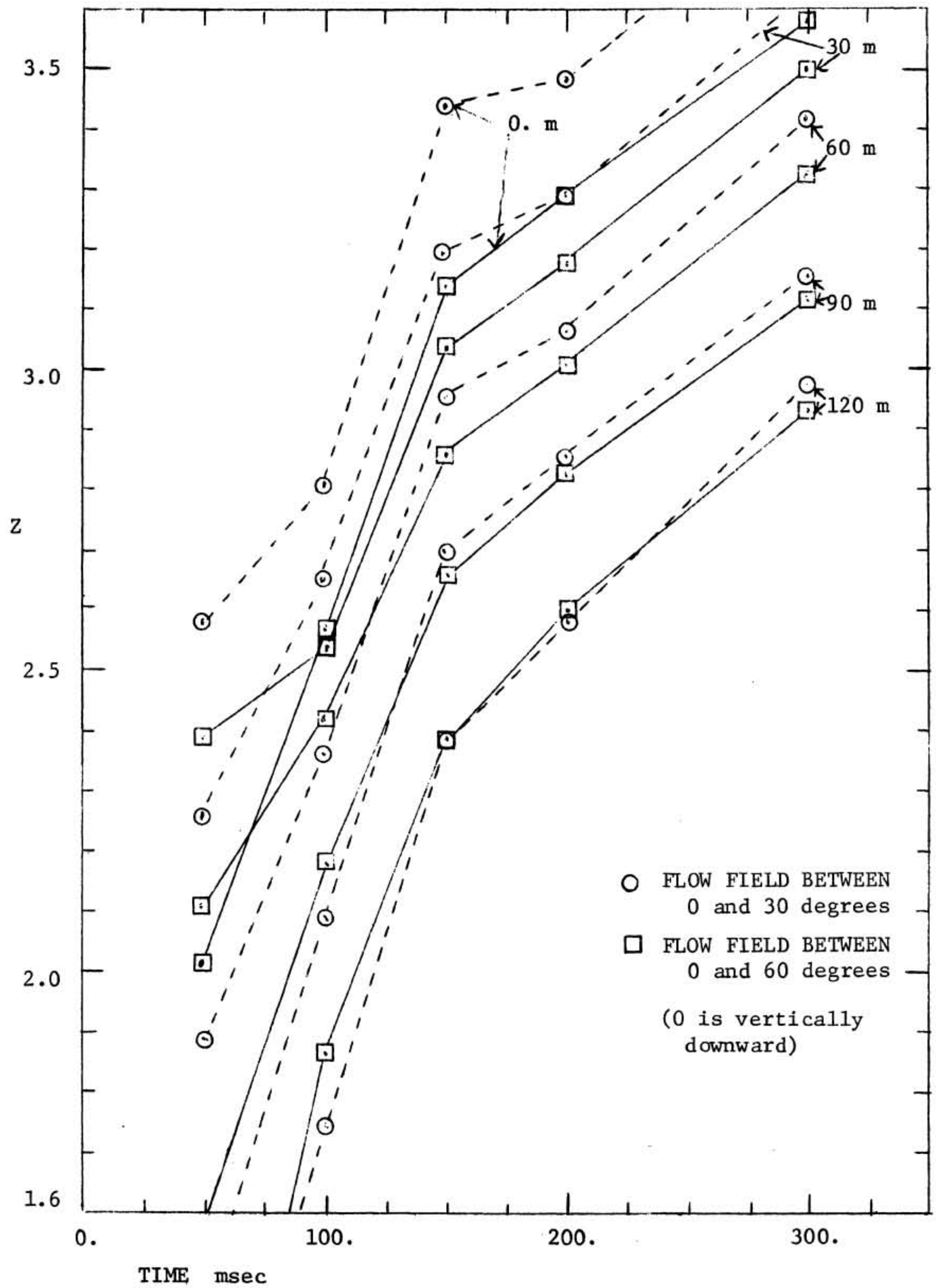

Figure 1. Z values for calculation GA1 for flow field centers at 0, 30, 60, 90 and 120 m depth. Average Z values for indicated part of flowfield.

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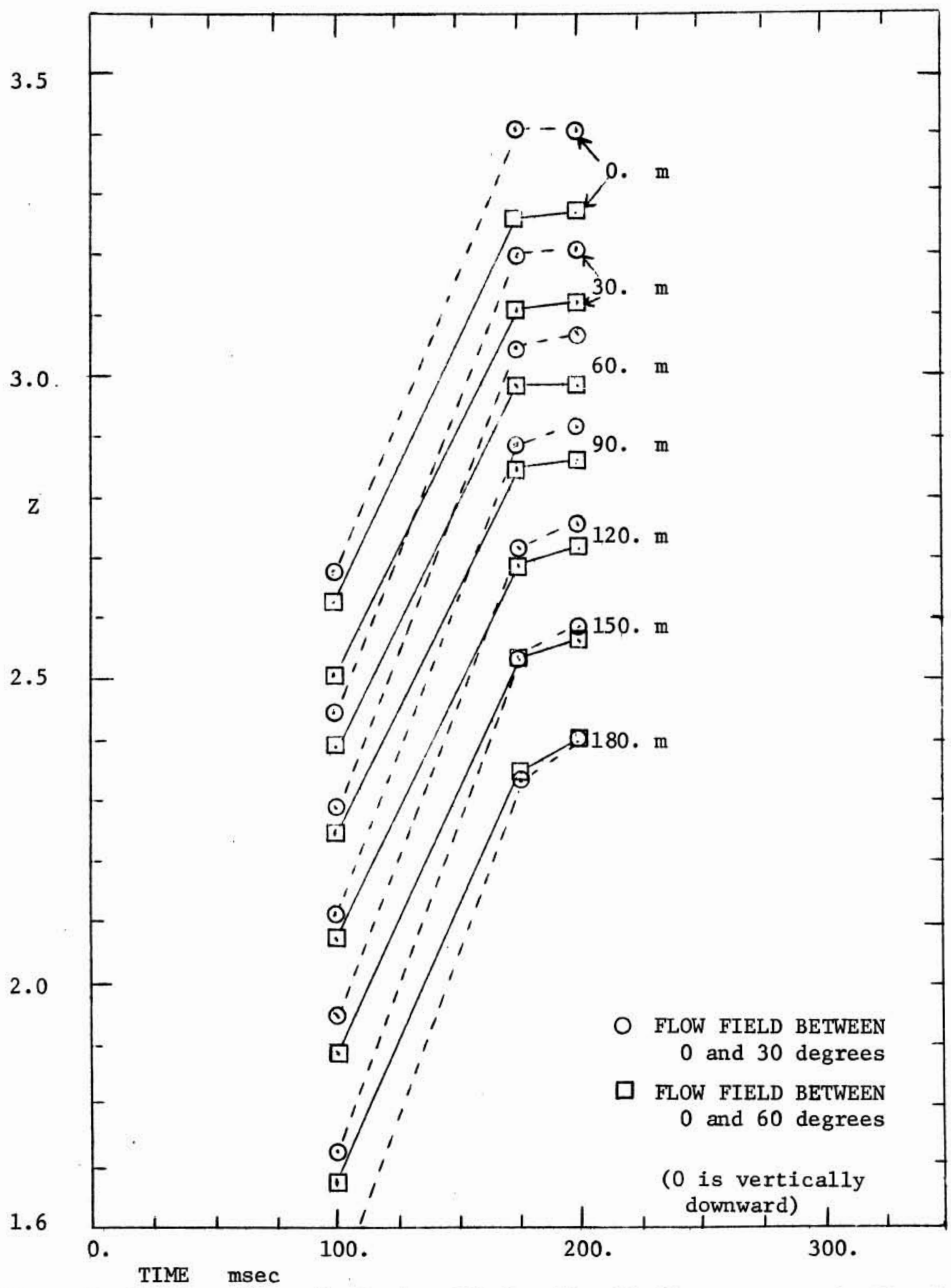

Figure 2. Z values for calculation GA2 for flow field centers at 0, 30, 60, 90, 120, 150, and 180 m depth. Average Z values for indicated part of flow field: between 0 and 30 or between 0 and 60 degrees.