Structural Response of the Earth's Crust to an Extra-Terrestrial Source of Stress by Identifying its Characteristic Pattern

Bibhasvata Dasgupta[1] (bdasgupta03@gmail.com)

The earth's crust is a geodynamic realm, which is constantly evolving. Due to its dynamic nature, the crust is constantly being subjected to remodelling. The earth's crustal response to stress is a result of isostatic compensation. The crust is also a living proof of yesteryears' dynamics. Extra-terrestrial agents of deformation refers to meteorites, asteroids etc. These are catastrophic events that influence a larger area (considering larger impact bodies). They effect the crust from outside, hence leave behind very specific structural signatures.

Consider an extra-terrestrial object impacting the earth's crust. The problem can be broken down into 3 parts: Pre Impact (kinematics of the object and nature of surface of impact); Syn Impact (dissipation of energy and formation of crater); and Post Impact (structural response, geophysical anomalies and effect on biota)

Upon impact, the projectile penetrates the earth's crust to a depth of twice its diameter. Shock waves generated due impact propagate in all possible directions. The reflected waves cause complete melting and vaporization of the impact body. At the same time, increased internal energy of the system melts the target rock. Depending on the thickness and density of crustal matter, its' interaction with the mantle is determined. Data collection from such impact sites is the first step towards its theoretical modeling. Integrating geophysical (seismic, magnetic), paleomagnetic, geochemical and geo-chronological data one can determine the kinematic parameters that governed the event. A working model that illustrates the crustal responses to extraterrestrial stress of extreme magnitude cannot be qualitative. Hence the most fundamental thing at this point is quantification of these parameters. The variables form a 'mass-energy equation', a simple theorem in Classical Physics. This project is directed to give the equation its shape. The equation will be the foundation on which the simulation model will rest.

Mass energy equation for Hyper velocity bolide impact mechanics:

E1 + E2 = E3 + E4 + E5