microsecond timescale commonly accepted for shock metamorphism. This has two important implications for shock processes: (1) when considering the pressure required to produce high-pressure minerals during a shock event, one must also consider the duration of the event as a variable that will control the pressure overstep required for the transformation; and (2) because the duration of shock events is controlled by the size of the impacting bodies [15], timescales determined from the microstructures of shocked minerals may provide information about the size of impact events in our solar system.

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LIMITATIONS TO USING SCALING LAWS FOR CONSTRAINING THE K/T SOURCE CRATER.

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Estimates of Chicxulub's diameter range from ~180 km [1] to ~300 km [2]. Recently three theoretically based objections to the ~300-km estimate have been raised. Argument I [3] states that the projectile would contain more Ir than the estimated ~2.5×10^{11} kg in the K/T boundary. This assumes that the object was a chondritic asteroid impacting at 20 km s^{-1}. But impact structures >100 km in diameter are far more likely to be produced by comets [4], which travel at higher velocities and have their masses augmented by nonchondritic materials (ices, organics). Scaling relationships [5] indicate that a 15-km-diameter long-period comet ($\rho = 1100$ kg m^{-3}; v = 57 km s^{-1}; 30% chondrite) could produce a transient crater sufficient to generate, upon collapse, an ~300-km final basin.

Argument II asserts that the distal ejecta deposits would be thicker than the K/T boundary deposits throughout the western hemisphere [6,7]. This is based on modeling ejecta thickness, t, as a power function of range [8]: $t = f(T)(r/R)^{-3.0 \pm 0.5}$, where T is ejecta thickness at the rim, R is the crater radius, and r is the radial range. The empirical support for this equation was small-scale explosion and pre-Apollo lunar crater measurements. First of all, terrestrial application of this relationship ignores the influence of atmospheric effects that would modulate ejecta distribution. Second, our assessment of digital elevation models of postmare lunar craters indicates that a −3.5 power law only holds for $r/R < 2.5$, with more distal regions showing considerably steeper falloffs. Additionally, the average falloff is steeper for larger craters than for smaller ones. Consequently, it is inappropriate and misleading to use this relationship to predict distal ejecta (r/R » 5 [7]) thicknesses around a large terrestrial impact crater.

Argument III maintains that too much melt would be produced in such a large crater [7]. This challenge is based on melt scaling relationships similar to those of [9] where melt volume $V \propto D_{TC}^{-3.85}$ and D_{TC} is the transient crater diameter. Problems with this approach include (1) the Chicxulub melt volume and composition are very poorly constrained. The target is a mixed assemblage containing abundant volatile-rich units that may inhibit melt sheet formation [10]; and (2) theoretical models characteristically overpredict the amount of melt produced. Regression of estimated preerosional melt volumes for 12 structures as large as Sudbury [9] indicates $V = 8.3 \times 10^{-4} D_{TC}^{-3.38}$. Using this relationship and the liberal estimate of D_{TC} = 148–195 km for Chicxulub, we calculate a melt volume of 2.6×10^4 to 6.6×10^4 km^3. This is an order of magnitude less melt than the model prediction [7], and is equivalent to that calculated by [7] using D_{TC} = 98–113 km.

Because these three objections suffer from rigid or inappropriate input assumptions and poor physical constraints, they add little to the issue of the size, energy release, and predicted frequency of extinction-causing impacts on Earth.

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RHENIUM-OSMIUM IN PALLASITE AND MESOSIDERITE METAL.

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We have reported whole-rock Re-Os data on iron meteorites from groups IAB, IIAB, IIIAB, IVA, and IVB [1]. The data from all groups are consistent with the well-defined isochron for group IIAB, with a slope of 0.07848 ± 0.0018 (corresponding to an age of 4.61 ± 0.01 AE, for $\lambda[^{187}Re = 1.64 \times 10^{-11} a^{-1}]$) and initial $^{187}Os^{188}Os = 0.09563 \pm 0.00011$ (all uncertainties are 2σ). The data on group IVA suggest the possibility of an older age (by 40–50 m.y.), which is qualitatively consistent with the relative chronology based on ^{107}Pd-^{107}Ag [2]. The Re-Os data are also in general agreement with the work of Horan et al. [3] and Smoliar et al. [4], except for the data on IVAs, that appear to be younger in the latter work, and which also include meteorites which show some evidence of disturbed Re-Os systematics. Here we report Re-Os data on metal extracted from pallasites and mesosiderites. The data shown in Fig. 1 are the new data relative to the IIAB reference isochron from our earlier work [1]. The pallasites include Eagle Station (ES) and the Main Group (MG) members Thiel Mountains and Marjalahti [5]. The pallasite data fall precisely on the IIAB isochron, within 2‰ in $^{187}Re/^{188}Os$, and are consistent with the same age and initial $^{187}Os/^{188}Os$. The pallasite data also show a reasonable range in Re/Os (e.g., 30% of the range exhibited by the IIABs), which permits an independent age determination for the pallasites alone (e.g., T = 4.58 ± 0.05 AE, 2σ). The data on Marjalahti and on ES have similar Re/Os and Os isotopic compositions, despite a factor of 5.6 range in Re and Os concentrations. The Re-Os data do not permit a distinction between ES and the MG pallasites or between ES and whole-rock samples of irons, despite the unique O composition of ES [6]. The pos-

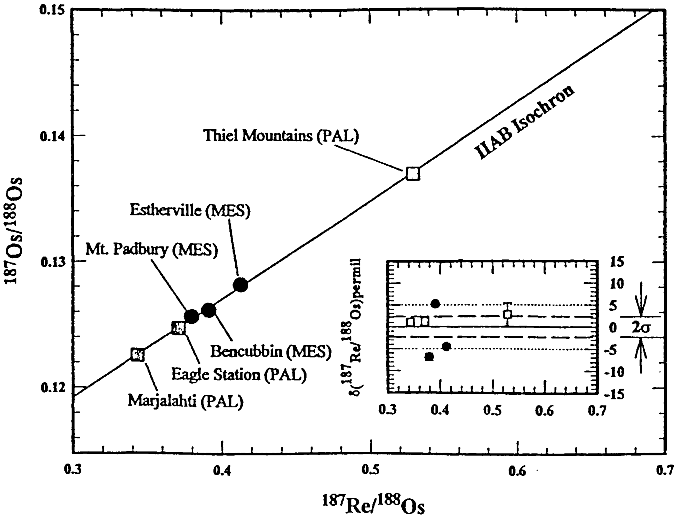

Fig. 1. Rhenium-osmium evolution diagram for pallasite and mesosiderite metal.