CAUSAL LINK BETWEEN FLOOD BASALTS AND LARGE IMPACTS: WERE THE K-T AND P-TR IMPACTORS 'VERNESHOTS' FIRED FROM TERRESTRIAL PLUME-FED CO2-GUNS?

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Both bolide impacts (Alvarez et al., 1980) and Continental Flood Basalt (CFB) events (Courtillot, 1996; Courtillot et al., 1994; Morgan, 1986) have been proposed to be the cause of the three largest Phanerozoic mass-extinctions. The Cretaceous-Tertiary (K-T) boundary is the age of both one of the largest known terrestrial impact structures (the Chixculub site on the Yucatan peninsula) and a very large continental flood basalt (the Deccan Traps event, the first well-documented trace of the Reunion plume-hotspot). In the past year, two papers (Becker et al., 2001; Kaiho et al., 2001) have suggested that the Permian-Triassic (P-Tr) boundary, the age of the largest well-documented CFB (the Siberian Traps), is also marked, in some marine sediments, by the geochemical signature of a large bolide impact. If correct, this would require that both a bolide impact and a CFB occurred at the P-Tr boundary. Finally, the Frasnian-Famennian (Late Devonian) event appears to be contemporaneous with an impact or impacts (e.g. Siljan Ring - Grieve and Robertson, 1987), the eruption of both a Siberian Kimberlite field (Agashev et al., 2001), and the Dniepr-Donets CFB (Wilson et al., 1996).

Both large bolide impacts (<once every 100 Ma) and continental flood basalts (once every 30-50 Ma) occur very infrequently. The odds of two such simultaneous events occurring by chance within the past 400 Ma are only 1 in 22,500, odds so unlikely that is seems prudent to consider a causal link. Most obvious is the intuition that somehow a bolide impact can trigger a flood basalt. However, in Deccan there appears to be good evidence that the 'impact event' occurred during, not before, flood basalt activity, as the iridium-rich K-T anomaly appears to occur well within the flood-basalt stratigraphy (Bhandari et al., 1994). Therefore, here we examine whether terrestrial processes can produce the 'signal' of an extraterrestrial impact event.

We explore a physical model where sub-cratonic plume activity leads to massive C- and S-volatile build-up at 80-100km depths within cold cratonic lithosphere, consistent with recent E-M soundings (Jones et al., 2001) beneath the Slave Craton (Canada). If this gas-rich phase can build up to a 1% fraction, than its catastrophic release may be large enough to be the environmental shock that leads to a mass extinction event.

Furthermore, its release would supply large amounts of plume mantle rare-gases (and possibly core-entrained iridium?) to the surface environment. Such super-kimberlite-precurser gas-release events appear capable of providing a terrestrial source for the recently found geochemical signals of ‘extraterrestrial’ P-Tr bolide impacts, while also better explaining the massive mantle-linked geochemical anomalies (in particular S-isotope excursions) that take place at this time. Furthermore, the energy release from sudden cratonic CO2 escape is large enough, that if released at one time, it could eject a suborbital mass-jet that causes a secondary impact event itself. Was even the Chix-culub impactor such a ‘Verneshot’, fired from a Deccan-Reunion plume CO2-gun?