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K/T(Pg) 境界：星雲遭遇による新案
K/T(Pg) boundary : A new proposal of collision of Dark Cloud.

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The Earth has undergone mass extinction five times over the course of 600 Ma in Phanerozoic eon. Alvarez et al. (1980) first pointed out that an impact of an extraterrestrial body causes Cretaceous-Tertiary extinction at 65 Ma. Although they also studied the possibility of supernova explosion in the same paper, they conclude that it is unlikely because the 191Ir/193Ir ratio is consistent with solar abundance. In fact, Chicxulub crater in Mexico is thought to be the cause of the Cretaceous-Tertiary extinction (e.g., Schulte et al. 2010). However the recent studies revealed that the asteroid impact has several difficulties to explain the extinction event.

First of all, the solid particles and sulphate launched by the asteroid impact are settled down in relatively short time-scale and the climate forcing from them become negligible after ten years from the impact (Kring et al., 1996). It seems rather difficult to achieve a complete extinction of dinosaurs by just one event with such a short period less than few years. In addition the earth has undergone several asteroid impacts such as Manicouagan crater, however these impact has not caused the mass extinction. Second, the diversities of the species, such as dinosaur, ammonaite, and foraminifer, living in the Cretaceous period start to decrease in their bio-diversities well prior to the K/Pg boundary (Sloan et al.,1986; House, 1989; 1993, Thomas, 1990). Furthermore, Zachos et al. (1989) pointed that the substantial reduction in oceanic primary productivity persisted for 0.5 Myr before the carbon isotope gradient was gradually re-established. In addition, the stable isotope and preservational data indicate that environmental change, including cooling, began at least 200 kyr before the Cretaceous-Tertiary boundary, and a peak warming of 3 degree in Celsius occurred 600 kyr after the boundary event. This cooling climate and the reduction of reduction in primary productivity that started 200 kyr before the boundary and last for at least 0.7 Myr, cannot be explained by the direct consequence of an asteroid impact.

In order to explore the real reason of this mass extinction at the K/Pg boundary, we studied the data of Iridium in the deep sea sediment around the K/Pg boundary and found a broader component of a significant enhancement in Iridium density around the central peak, which probably correspond to the asteroid impact. The width of this broad component, which is difficult to explain by mixing or remobilization after an instantaneous deposition (Hull et al., 2010). This broader component in Iridium could be caused by an increased flux of cosmic dusts due to the encounter to a dark cloud across. The sunscreen effect of cosmic dust in stratosphere may lead a global cooling (Pavlov et al. 2005). The flux of sub-GeV component of cosmic rays increased by a large factor due to the dense molecular gas from dark cloud to lead the destruction of ozone layer (Kataoka et al. 2012). Such an environmental catastrophe, which continued several ten Myears, may be the real reason of the mass extinction at K/Pg boundary.

The asteroid impact at K/Pg may also be one of the consequences of the dark cloud; encounter with a giant molecular cloud is well massive to perturb the orbit of asteroid/comet by its gravitational potential to lead an asteroid/comet shower. In fact, there is increasing evidence that the end of the Cretaceous experienced multiple impacts. A few craters are reported in late Maastrichian stage. In addition, K/Pg and late Maastrichtian Ir and Platimun Group Elements (PGE) anomalies have been reported from Oman (Ellwood et al. 2003). Another impact may have occurred in the early Danian as suggested by Ir and PGE anomaly patterns (e.g., Stuben et al. 2002). The multiple impacts may be induced by a dark cloud encounter. Of course, some of the Ir and PGE anomalies mentioned above can be directly caused by the accretion of the cosmic solid particles from the dark cloud itself.

Keywords: mass extinction, dark cloud, K/T(Pg) boundary, dust, asteroid impact, deep sea