*Asteroids.* In 50-ties physico-chemical study of meteorites by H. Urey led him to the conclusion that these bodies had been formed from asteroidal size bodies. At the same time O. Schmidt suggested that the formation of a normal planet in the asteroidal zone (AZ) had been prevented by Jupiter's perturbations. Theory of formation of the asteroid belt should answer two main questions: (1) How random velocities of the asteroid zone bodies (AZB) at an early stage became so high to prevent further growth? With the present velocities of 5 km/s practically all collisions lead to disruption. (2) How to remove from AZ more than 99.9% of the initial mass of solid matter which exceeded the mass of the Earth? The study of accumulation of bodies in the Jupiter's zone (JZB) has shown (1) that when protoJupiter reached a few tenths of the Earth's mass, eccentricities of JZB orbits became large and they penetrated into AZ. It has been suggested that these JZB being much larger than AZB (due to high fraction of volatiles) sweeped most AZB from AZ at collisions and increased their random velocities at close encounters. Later it has been estimated that only about a half of the total mass of AZB could be removed by JZB (2). In the model of a runaway growth of planet embryos with very small random velocities $\nu$ of bodies (parameter $\theta \propto \nu^{-2}$ is about $10^3$), Jupiter can form during $10^6$ yr, but other JZB grow slower. Due to small $\nu$ they reach AZ essentially later and sweep out AZB less effectively. Hence moderate values of $\theta$ are preferable: ~20–30 in JZ and 10–15 in AZ. More rapid growth of JZB relative to AZB can be provided only at higher surface density of condensate in JZ $\sigma_p \sim 15$–20 g/cm$^2$ and therefore at a more slow decrease of the density of gas in the solar nebula (SN) than is usually assumed. To solve the question (2) an additional mechanism of removal of AZB is needed. The scanning of resonances through the AZ during a dissipation of gas from SN (3) needs a loss of mass nearly that of the sun. In the more preferred SN model of small mass ($\lesssim 0.1$ M.) another mechanism of resonance scanning through AZ could exist—a variation of the Jupiter's distance from the sun at the stages when Jupiter accreted the gas and when it ejected bodies from the solar system.

*Comets.* At the final stage of accumulation many preplanetary bodies were expelled from the solar system and into outer Oort cometary cloud ($R > 20\,000$ a.u.) by gravitational perturbations of giant planets. Due to "recoil" effect which decreased the distances of the planets from the sun the expelled mass could not be large: $\lesssim 10^2$ $m_\theta$. Formation of comets *in situ* in the model of small mass SN is possible at distances R not more than several hundreds of a.u., their total mass being $< 10^3 m_\theta$. References: (1) Safronov V. S. (1969) *Evolution of the Protoplanetary cloud and Formation of the Earth and the Planets.* Moscow, Nauka; NASA TTF-677(1972). (2) Safronov V. S. (1979) In *Asteroids* (ed. T. Gehrels), Univ. Ariz. Press, pp. 975–991. (3) Cameron A. G. W. and Pine M. (1973) *Icarus* **18**, 377–406.

**Applications of statistics to Antarctic, non-Antarctic differences.** Stephen M. Samuels. Dept. of Statistics, Purdue University, W. Lafayette, IN 47907, USA.

Linear Discriminant Analysis and Logistic Regression, Afifi and Clark (1984) and Flury and Riedwyl (1988), effectively distinguish between Antarctic and non-Antarctic H or L Chondrites solely on the basis of their trace element compositions. This is true both overall and for strongly shocked L4–6 chondrites. As with any statistical analysis of this kind, we conclude only that the data *support* one hypothesis (the hypothesis of a difference), and are *inconsistent* with another (the hypothesis of no difference). Our statistical argument says nothing whatsoever about the *causes* (if any) of such differences.

Numerous analyses have been performed and will be reported on. These are based on the data in Dennison and Lipschutz (1987), Huston and Lipschutz (1984), Kaczarel *et al.* (1989), Lingner *et al.* (1987), Neal *et al.* (1981), and Walsh and Lipschutz (1982).

For example, when the 11 shocked Antarctic L4–6 chondrites in Kaczarel, *et al.* (1989) were compared with the 18 shocked non-Antarctic L4–6 chondrites (for which data was available for all 13 trace elements) in Huston and Lipschutz (1984), the Discriminant Function values had very slight overlap and the significance level was 0.0062, indicating that identical multivariate normal populations have only about one chance in 160 of looking as different from each other as do these two groups of samples. Logistic Regression (using SAS PROC LOGIST) on the same two groups of shocked L4–6 chondrites correctly classified all the samples, assigning probabilities (of "belonging to the Antarctic population") 0.995 or greater to each of the 11 Antarctic samples, and 0.0002 or less to each of the 18 non-Antarctic samples.

Validation Runs are necessary, in both Discrimination Analysis and Logistic Regression, to avoid giving too rosy a picture. In such runs, part of the data (the training cases) are used to generate a discriminant function or a logistic regression function, which is then applied to the rest of the data (the validation cases). A high rate of correct classifications of these validation cases reinforces the argument for a real statistical difference between Antarctic and non-Antarctic meteorites. For the shocked L4–6 chondrites cited above, repeated runs with 20% (randomly selected) validation cases resulted in over 80% correct classification by both methods. References: Afifi A. A. and Clark V. (1984) *Computer-Aided Multivariate Analysis,* 245–306. Dennison J. E. and Lipschutz M. E. (1987) *Geochim. Cosmochim. Acta* **51,** 741–754. Flury B. and Riedwyl H. (1988) *Multivariate Statistics: A Practical Approach,* 88–123. Huston T. J. and Lipschutz M. E. (1984) *Geochim. Cosmochim. Acta* **48,** 1319–1329. Kaczaral P. W., Dodd R. T. and Lipschutz M. E. (1989) *Geochim. Cosmochim. Acta* **53,** 491–501. Lingner D. W., Huston T. J., Hutson M. and Lipschutz M. E. (1987) *Geochim. Cosmochim. Acta* **51,** 727–739. Neal C. W., Dodd R. T., Jarosewich E. and Lipschutz M. E. (1981) *Geochim. Cosmochim. Acta* **45,** 891–898. Walsh T. M. and Lipschutz M. E. (1982) *Geochim. Cosmochim. Acta* **46,** 2491–2500.

**Chemical diaplectic changes of plagioclases from impactites (Popigai and Puchezh-Katunk astroblemes, USSR).** L. V. Sazonova and N. N. Korotaeva. Moscow State University, Geological Department, Petrography chair, Moscow, USSR.

Plagioclases (Pl) from target impacted rocks have been studied by the method of microprobe analyses (Popigai and Puchezh-Katunk Astroblemes). Chemical composition of Pl does not change at the average rock pressure of 20 GPa. Na content decrease has been observed only in the smallest fusion zones appearing in planar features. Weak but observable Na diffusion has been noted in maskelynite (30 GPa). Na diffusion intensity increases sharply when separate fused regions in maskelynite appear due to non-homogeneous shock wave distribution and local heating of the substance K is brought into the fused regions (Table 1). At higher shock pressures and residual temperatures Ca begins to diffuse. It is either removed or redistributed in the grain (Table 1). The greater part of the grain is fused, the more intense the alkali redistribution processes become (up to the complete removal of Na). Pl shock fusion usually begins by a definite twinning system. With pressure increase fusion part of Pl grains increases.

TABLE 1. Alkali content in reference to the mineral formula.

| | Popigai | | | | Puchezh-Katunk | | | |
|---|---|---|---|---|---|---|---|---|
| | Ca | Na | K | | Ca | Na | K | |
| Target Pl | 0.27 | 0.70 | 0.02 | 0.99 | 0.42 | 0.55 | 0.02 | 0.99 |
| Diaplactic glass | 0.28<br>0.25 | 0.58<br>0.67 | 0.04<br>0.04 | 0.90<br>0.96 | 0.43<br>0.43 | 0.42<br>0.45 | 0.01<br>0.02 | 0.85<br>0.90 |
| Fused glass | 0.30<br>0.30 | 0.23<br>0.23 | 0.11<br>0.11 | 0.64<br>0.64 | 0.53<br>0.33 | 0.12<br>0.16 | 0.16<br>0.07 | 0.81<br>0.55 |

**Rb-Sr and U-Pb systematics in highly shocked minerals: Haughton Impact Structure, Arctic Canada.** U. Schärer[1] and A. Deutsch.[2] [1]Univ. du Québec à Montréal, C. P. 8888 Succ. A, Montréal, Canada H3C 3P8. [2]Inst. f. Planetologie, Univ. Münster, D-4400 Münster, FRG.

Response of isotope systems to shock-wave metamorphism was studied on a crystalline rock fragment (shock-stage III; ~50 GPa) of the polymict breccia from the 23 Ma old (1, 2) Haughton crater (Devon Island). For comparison, age dating was also performed on the unshocked crystalline basement at Sverdrup Inlet. There, last major chemical fractionation occurred at 1903.3 ± 0.5 Ma (monazite U-Pb age; 2 sigma). The Rb-Sr system of the identical rock closed at 1814 ± 8 Ma (WR - biotite - feldspar).

**Rb-Sr measurements** on the shocked clast show the WR, biotite, and feldspar-glass in isotopic disequilibrium. Biotite suffered strong deple-