AN ITALIAN SCIENTIFIC EXPEDITION IN TUNGUSKA

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1.

In July 14–30, 1999 an Italian scientific expedition was carried out in Tunguska (Siberia), the region of the 1908 explosion of a cosmic body (see Di Martino, M. et al., 1998, and references therein). The expedition, named "Tunguska99", was organized by the Department of Physics of the University of Bologna, in collaboration with the Turin Astronomical Observatory and the Institute of Marine Geology (CNR Bologna) and with the local support of personnel and researchers of Tomsk University (Russia). The "Tunguska99" expedition is a contribution to the international programs on the detection and physical study of asteroids and comets potentially dangerous to humankind.

The participants and the equipment of the expedition were transported from Italy to Krasnoyarsk by a Russian Iljushin IL-20M aircraft of the "State Research Institute of Aviation Systems" (GosNIIAS) and from Krasnoyarsk to Tunguska by a MI-26 helicopter. To perform the expedition tasks, a camp has been built in the taiga at some hundred kilometers from centers connected by roads. The recent expedition had broader tasks in comparison with those of the first Italian expedition organized by the University of Bologna in 1991 to search in tree resin for microparticles from the cosmic body (Longo et al., 1994; Serra et al., 1994). The main tasks of the "Tunguska99" expedition were : 1) to study the structure and sediments of Cheko, a small lake located near the epicenter of the Tunguska event; 2) to carry out an aerial photosurvey of the explosion site; 3) to collect wood, peat and rock samples; 4) to monitor gamma rays during the flight Italy-Siberia-Italy and in Tunguska.

2.

We carried out a geophysical/sedimentological study of the lake Cheko, a small ($\sim$ 500 m diameter) lake located 8 km from the epicenter. Our work had two main objectives : 1) to verify whether the formation of the lake can be correlated to the 1908 event; 2) to detect in the lake sedimentary sequence, geophysical and geochemical evidences of the event that can give information on the nature of the cosmic body.

The field study included the acquisition of the following data : a) acoustic morphobathymetry; b) bottom reflectivity; c) side scan sonar surveys; d) low frequency acoustic profiling for sub bottom penetration; e) ground penetration radar surveys to detect sublake floor structures (Pipan et al., 2000); f) sediment coring.

The future work will focus on the core analysis, and on the detection of possible physical effects within the sedimentary successions (i.e. gravitative failures of the slopes) that could give important insights on the energy of the event.

3.

An aerophotographic multispectral survey has been carried out by using the Iljushin IL-20M aircraft of the "State Research Institute of Aviation Systems" (GosNIIAS). The aerophotographic survey covered a surface of more than 250 km^2 between the latitudes 60^o 50' 00" N and 60^o 58' 30" N and between the longitudes 101^o 45' 00" E and 102^o 05' 00" E. The photos have been taken in the scale 1 : 8000 and 1 : 14000 with coverage of 60% (long.) and 30% (lat.). In parallel, a line scanner made simultaneously a survey in 6 spectral bands, from optical to thermal infrared : 0.43–0.51 μm, 0.50–0.59 μm, 0.61–0.69 μm, 0.76–0.90 μm, 1.5–2.5 μm and 8.0-12.5 μm. During the flight, the aircraft position was continuously monitored with a GPS system and the geographical coordinates were linked to the photographs. Contemporarily, we have measured on the ground the geographical coordinates of different reference points in the same area. The GPS measurements on ground have been performed with an error less than 20 m. The results of the aerophotosurvey and of the topographic measurements on ground will be used to re-examine the aerophotographic material, obtained in 1938 under the direction of L.A. Kulik (Kulik, 1939 and 1940) in order to check some details of the 1908 explosion and to verify one recent hypothesis on the event (Nikolaev, 1998).

4.

Wood samples from trees surviving the 1908 explosion have been collected at different distances from the "epicenter" in order to further the investigation carried out by the first Italian expedition in 1991. A piece of peat (50 x 20 x 70 cm) has been taken at about 500 m from the lake Cheko. Isotopic analysis and pollen examination will be carried out to find indications on the composition of the cosmic body. The pollen deposited in cores of Cheko lacustrine sediments and in the peat sample in layers preceding and following the Tunguska event will be investigated. For this purpose samples of flowers has been collected in different places of the site. The pollen study should make it possible to obtain information on vegetation changes due to the 1908 impact. The petrology and geochemistry of the Mesozoic igneous rocks outcropping in the Tunguska region is being studied. Collected pieces of the so-called "John rock" will be analyzed to obtain evidence about its terrestrial or cosmic origin. Two kilograms of gravel from the bottom of the lake is under examination to find whether the vitrification should be connected to volcanism or to the Tunguska event.

5.

One detector of the VRC (Cosmic Ray Variation) group of the University of Bologna has monitored gamma rays both during the flights Italy–Siberia–Italy and during the two–week stay in the Tunguska Natural Reserve. The group has used in the past similar detectors to study gamma ray variation in dependence of solar activity, of the geomagnetic field, and of the environmental conditions in Italy, Antarctica, Svalbard islands, Himalayas and during the sea voyages Italy-Antarctica-Italy.

At the base camp, gamma rays from cosmic and environmental radiation have been continuously monitored on time scale of 15 minutes, in the 0.05–3 MeV and in the 3–10 MeV energy bands. Daughter radionuclides from the ^{238}U and ^{232}Th chains have been recorded close to the lake Cheko. The data are being processed to find other natural or man-made radionuclides. The in-flight measurements indicate significant cosmic ray flux variations as a consequence of solar activity.

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