



Asteroid 2008 TC3, Almahata Sitta meteorite and cosmogenic radioisotopes

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The asteroid 2008 TC3 was telescopically discovered prior to entering the Earth's atmosphere and was correctly predicted to fall 20 hours later in Sudan on October 7, 2008 [1]. It is the first time that an impacting meteoroid has been seen previously in space. It entered atmosphere with velocity of 12.4 km/s and fragmented at an altitude of about 37 km. However, in subsequent search campaigns, many fragments were collected from the Nubian desert and were named Almahata Sitta meteorites.

We present the measurement of the largest ureilitic fragment (#15; mass of 75 g) [2] performed at Monte dei Cappuccini Laboratory (IFSI, INAF) in Torino (Italy) using a sensitive gamma-ray spectrometer [3].

Galactic cosmic rays (GCR) produce a large number of radioactive and stable isotopes in meteoroids before they fall on the Earth where the GCR irradiation becomes negligible. In particular, each cosmogenic radioisotope preserves a record of the irradiation roughly over its mean life.

In this meteorite six cosmogenic radionuclides were measured: Sc-46, Co-57, Mn-54, Na-22, Co-60 and Al-26. Using the Co-60 and Al-26 activities and their production rate depth profiles, we deduced that the fragment was located at a depth of 41 ± 14 cm inside the 1.5–2 m radius asteroid. Na-22 activity is found to be slightly greater than expected on the basis of the average GCR flux and this could be ascribed to the unusually prolonged solar minimum preceding the meteorite fall.

[1] Jenniskens P., Shaddad M.H., Numan D. et al., The impact and recovery of asteroid 2008 TC3, *Nature*, 458, 485, 2009.

[2] Taricco C., Bhandari N., Colombetti P., Romero A., Vivaldo G., Sinha N., Jenniskens P., Shaddad M.H., Ballabh G.M., Cosmogenic radioisotopes in the Almahata Sitta ureilite, *Meteoritics & Plan. Science*, 45, 1743, 2010.

[3] Colombetti P., Taricco C., Bhandari N., Romero A., Verma N., and Vivaldo G., Experimental set-up for gamma-activity measurements of astromaterials, *IEEE Nuclear Science Symposium Conference Record, NSS'08*, 1802, 2008.