FALL, PETROLOGY, CLASSIFICATION, NOBLE GAS AND COSMOGENIC RECORDS OF KOMAR GAON METEORITE, THE LATEST FALL IN INDIA

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Introduction: Komar Gaon meteorite fell (26°56'98"N, 93°46'11"E) during the daylight (12:00 pm IST) on November 13, 2015 in Komar Gaon village of Golaghat district of Assam, India. The single piece of stone has a mass of ~12 kg and the local villagers witnessed the trail and subsequently observed its impact on a well ploughed field forming a 45 cm diameter by 90 cm deep hole. Brief description of the meteorite fall and preliminary report were cited elsewhere [1,2]. In this communication, we present the morphology, mineral chemistry, noble gas results and cosmogenic records of Komar Gaon meteorite, the latest fall in India.

Morphology, Mineralogy and Textural characteristics: Here we present an independent petrologic classification, using a sample collected by one of us. Morphological signatures of atmospheric flight are well documented in view of development of atleast three generation of fusion crusts with various colour and morphology. Well developed regmaglypts and distinct flow lines are also present to enable us to identify the front and rear side. The light grey matrix is recystallised and studded with disseminated sulphide-metal specs and therefore hard to recognize any chondrule in naked eye. Under BSE, we found presence of a very few chondrules (both PO chondrule and BO chondrule) in transparent coarsely recrystallised matrix - aggregate of mainly olivine (Fa: 24.9±0.68), low-Ca pyroxene (Fs: 21.14±0.4), Fe-Ni metal (Taenite and Kamacite) and troilite. Other minor and accessory mineral phases include high-Ca pyroxene (Wo: 44±0.7, En: 48±0.58, Fs: 8±0.85), chromite (Cr_2O_3: 53-56 wt%; FeO_t: 29-31 wt%) and merrilite (CaO: 50-52 wt%; P_2O_5: 40-42 wt%). Locally the shock veins (sometimes interconnencted) are also noticeable. Large secondary plagioclase (>60 μm), along with homogeneous silicate mineral composition suggest extreme thermal metamorphism (temp ~709°C based on olivine-chromite geothermometer) caused the equilibration that corresponds to petrologic type 6 [3]. Planar fracture and presence of irregular fracturing of olivine and pyroxene grains are the most diagnostic shock metamorphism features (shock stage atleast up to S3)[4].

Noble gas isotopes: Simultaneous measurements of noble gases and nitrogen carried out using Noblesse multi-collector mass spectrometer (Nu Instrument U. K.) once extracted from same aliquot of sample (Komar gaon - z) by step heating following standard procedures [5]. Neon is purely cosmogenic while Ar, Kr, Xe indicates Q-type trapped component. We calculate the cosmic ray exposure age (CREA) as 7 Ma (average of T_{21}, T_{38}, T_{83} and T_{126}). Lower T_3 is understandable due to He loss. The gas retention ages are K-Ar = 684 Ma and U-Th-He = 160 Ma suggest for possible gas loss. Complete gas loss can be excluded because a $^{129}Xe/^{132}Xe$ of 1.3 implies retention of radiogenic ^{129}Xe accumulated after accretion of parent body. Nitrogen content is 0.38 ppm while $\delta^{15}N$ yield a value of 18‰.

Cosmogenic radionuclide: We measure cosmogenic radionuclides (^{7}Be, ^{26}Al, ^{22}Na, ^{54}Mn and ^{57}Co) in a 200 g fragment of Komar Gaon meteorite using a 148 cm^3 volume ultra low background, high purity germanium gamma ray spectrometer housed in a 10 cm thick lead shield. The estimated activities for shorter half life radionuclides are a bit lower, but looks consistent with the expected behavior of galactic cosmic ray modulation due to solar activity as this meteorite fell just after the maxima of current solar cycle. Interestingly the activities are comparable to the Bhawad LL6 chondrite, which fell near the maxima of solar cycle 23 [6]. The absence of ^{60}Co radionuclide indicate that the preatmospheric size of the Komar Gaon may not be large.

Discussion: Komar Gaon is a highly equilibritated chondrite type and based on metal abundance (~5 vol%) and olivine composition (Fa:25), it is classified as L6, S3. Temperature of thermal metamorphism is calibrated close to 700°C. Melt veins are absent, however evidence of incipient shock veins suggest local scale disequilibrium melting. Based on noble gas results, the CREA implies that Komar Gaon belongs to the peak in cosmic ray exposure age distribution of ordinary chondrites [7]. $\delta^{15}N$ in Komar Gaon is well complied with typical ordinary chondrite. Absence of ^{60}Co further suggest that pre-atmospheric size of Komar Gaon is small and consistent with low thermal neutron flux and low shielding depth and also causes the low ^{26}Al activity.

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