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Petrology and geochemistry of Yamato 984028: a cumulate lherzolitic shergottite with affinities to Y 000027, Y 000047, and Y 000097

Amy J.V. Riches, Yang Liu, James M.D. Day, Igor S. Puchtel, Douglas Rumble III, Harry Y. McSween Jr., Richard J. Walker, Lawrence A. Taylor

We report the petrography, mineral and whole-rock chemistry (major-, trace-, and highly-siderophile element abundances, and osmium and oxygen isotope compositions) of a newly recognized lherzolitic shergottite, Yamato (Y) 984028. Oxygen isotopes ($\Delta^{17}O$ = 0.218‰) confirm a martian origin for this meteorite. Three texturally distinctive internal zones and a partially devitrified fusion crust occur in the polished section of Y 984028 studied here. The zones include: 1) a poikilitic region with pyroxene enclosing olivine and chromite (Zone A); 2) a non-poikilitic zone with cumulate olivine, interstitial pyroxene, maskelynite and Ti-rich chromite (Zone B) and; 3) a monomict breccia (Zone C). The pyroxene oikocryst in Zone A is chemically zoned from $Wo_{3-7}En_{76-71}$ in the core region to $Wo_{33-36}En_{52-49}$ at the rim, and encloses more Mg-rich olivine (Fo_{74-70}) in the core, as compared with olivines (Fo_{69-68}) located at the oikocryst rim. Constraints from Fe-Mg partitioning between crystals and melt indicate that constituent minerals are not in equilibrium with the corresponding bulk-rock composition, implying that Y 984028 represents a cumulate. The whole-rock major- and trace-element compositions, and initial $^{187}Os/^{188}Os$ value (0.1281 ± 0.0002) of Y 984028 are similar to other lherzolitic shergottites and this sample is probably launch-paired with Y 793602, Y 000027, Y 000047, and Y 000097. The Os isotopic composition and highly-siderophile element (HSE) abundances of Y 984028 and other lherzolitic shergottites are consistent with derivation from a martian mantle source that evolved with chondritic Re/Os.

Sm-Nd and Rb-Sr studies of lherzolitic shergottite Yamato 984028

C.-Y. Shih, L.E. Nyquist, Y. Reese, K. Misawa

The distribution pattern of the trace elements Rb, Sr, Nd and Sm for Yamato 984028 (Y984028) is consistent with its classification as a lherzolitic shergottite. The Sm-Nd mineral isochron of this lherzolitic shergottite defines its age to be 170 ± 10 Ma for an initial ε_{Nd} = +11.6 ± 0.2. The corresponding Rb-Sr mineral isochron yields an

identical age of 170 ± 9 Ma and an initial $^{87}Sr/^{86}Sr$ = 0.710389 ± 0.000029. The concordant Sm–Nd and Rb–Sr isochron ages suggest that Y984028 crystallized 170 ± 7 Ma ago contemporaneously with five other lherzolitic shergottites and ten enriched basaltic and olivine–phyric shergottites. The age, Sr– and Nd– isotopic signatures further suggest that Y984028 and Y–793605, and also probably Y000097 could come from a single magmatic body. Using a two–stage evolution model, the time–averaged $^{87}Rb/^{86}Sr$–ratio for the mantle source of the parent magma of Y984028 is ～0.182, within the range of 0.178–0.182 that has been reported for other lherzolitic shergottites. The corresponding time–averaged $^{147}Sm/^{144}Nd$–ratio for the source mantle of its parent magma is super–chondritic at ～0.217, implying its source was a depleted mafic part of the Martian mantle similar to that of diabasic shergottite Northwest Africa (NWA) 1460. Rb, Sr, Sm and Nd distributions in Y984028 are likely produced by pyroxene and olivine accumulation, probably from a NWA 1460–like parental melt, in an intrusive magma body

Spectroscopy of Yamato 984028

M.D. Dyar, T.D. Glotch, M.D. Lane, B. Wopenka, J.M. Tucker, S.J. Seaman, G.J. Marchand, R. Klima, T. Hiroi, J.L. Bishop, C. Pieters, J. Sunshine

Comprehensive spectroscopic characterization of interior and exterior chips of the lherzolitic shergottite Y–984028 has been performed using results from six techniques. Data from UV–visible–near–IR reflectance spectra, thermal (mid–IR) emission spectra, attenuated total reflectance (ATR) spectra, transmission FTIR spectra, Raman microprobe spectra, and Mössbauer spectra of whole rock and mineral separates from this meteorite are integrated and compared. Five of these analytical techniques accurately determined the ～Fo_{65} composition of the olivine within ±10 mol%. Both transmission FTIR and ATR spectra show broad features near 3500 cm^{-1} indicating the presence of OH/H_2O that does not arise from surface water adsorption. The brown color of the Y–984028 olivine is likely due to the presence of nanophase metallic iron particles ($npFe^0$) dispersed throughout the olivine during a major shock event on Mars. Y–984028 olivine also contains a significant amount of Fe^{3+}, but this cannot be distinguished from Fe^{3+} that is present in pyroxene and possibly clay minerals. This meteorite and the nakhlite MIL03346 are the two most oxidized of the SNC meteorites studied to date, with Fe^{3+} contents consistent with high–temperature equilibration near the QFM oxygen buffer.

Petrography of Yamato 984028 lherzolitic shergottite and its melt vein: Implications for its shock metamorphism and origin of the vein

Shin Ozawa, Masaaki Miyahara, Eiji Ohtani, Makoto Kimura, Yoshinori Ito Yamato 984028 (Y984028) is a newly identified lherzolitic shergottite, recovered from the Yamato Mountains, Antarctica, in 1999. As part of a consortium study, we conducted

petrographic observations of Y984028 and its melt vein in order to investigate its shock metamorphism. The rock displays the typical non-poikilitic texture of lherzolitic shergottite, characterized by a framework of olivine, minor pyroxene (pigeonite and augite), and interstitial maskelynite. Shock metamorphic features include irregular fractures in olivine and pyroxene, shock-induced twin-lamellae in pyroxene, and the complete conversion of plagioclase to maskelynite, features consistent with those found in other lherzolitic shergottites. The melt vein is composed of coarse mineral fragments (mainly olivine) entrained in a matrix of fine-grained euhedral olivine (with several modes of compositional zoning) and interstitial glassy material. Some coarse olivine fragments consist of an assemblage of fine-grained euhedral to subhedral olivine crystals, suggesting shock-induced fragmentation, recrystallization, and/or a process of sintering. The implication is that the fine-grained olivine crystals in the matrix of the melt vein represent complicated crystallization environments and histories.

Petrology and mineralogy of the shock-melted H chondrites Yamato-791088 and LaPaz Ice Field 02240

Takafumi Niihara, Naoya Imae, Keiji Misawa, Hideyasu Kojima

We studied the petrology and mineralogy of two types of shock-melted H chondrites: Yamato (Y)-791088 and LaPaz Ice Field (LAP) 02240. Y-791088, which consists of numerous coarse-grained relict phases (40%) and euhedral fine-grained minerals solidified from the shock melt (60%), experienced incomplete melting; a quiescent melt is indicated by the existence of abundant relict phases, pseudomorphed chondrules, and two types of glass. LAP 02240, which consists of small amounts of coarse-grained relict phases (～10%) and fine-grained minerals (～90%), experienced near-complete melting; a rapidly cooled mobilized melt is indicated by the homogeneous compositions of glass and opaque veins.

The homogeneous compositions of relict olivines indicate that the precursors of both chondrites were equilibrated H chondrites. The melting features of Y-791088 and LAP 02240 are very similar to those of Y-790964 (LL) and the fine-grained lithology of Y-790519 (LL), respectively. These two types of shock-melted ordinary chondrites possibly formed *in situ* during dike formation. The quiescent melt is thought to have originated from the injection of shock-heated chondrite blocks into mobilized melt. These two types of melting could have occurred during dike formation on the H chondrite parent body. The textures of the two types of shock melts were not simply affected by the degree of shock melting: they were also controlled by the degree of shear stress.

GPS scintillation studies in the arctic region during the first winter-phase 2008 Indian Arctic Expedition

A.K. Gwal, Amit Jain

We present the results of scintillation studies based on the data obtained during the first winter-phase Indian Arctic Expedition in March 2008 at the Indian Himadri Station, Ny-Ålesund (78.9° N, 11.9° E), in the vicinity of the daytime cusp and under the nightside polar cap. A global-positioning-system ionospheric scintillation and TEC monitor (GISTM) receiver (model GSV4004A) was used to record scintillations and the total electron content (TEC). The polar ionosphere is more sensitive to phase than to amplitude scintillations. Occurrence of amplitude scintillation is confined to well-defined regions, while phase scintillation shows a strong characterization both in magnetic latitude and magnetic local time. Occurrence of amplitude and phase scintillation increases during disturbed compared with quiet days. During disturbed days, the phase-scintillation region is displaced towards lower latitudes, following the auroral oval. The observed noon peak in scintillation occurrence may indicate that the irregularities that generate scintillation are caused by precipitation in the daytime cusp/cleft region. A significant enhancement of the TEC and the rate of change of the TEC index (ROTI) signified transits of polar-cap patches across different satellite trajectories during geomagnetic storms. We found that patches are most likely to occur when IMF Bz is southward and/or $K_p > 4$. Loss of signal lock was more for the L2 signal than for L1, and shows a maximum in the morning sector. Positional errors tend to increase during disturbed conditions.

Three lecideoid lichens new to Svalbard, Norway

T. Inoue, S. Kudoh, M. Inoue, M. Uchida, H. Kanda

We report three lichen species, *Lecidea apochroeella* Nyl., *Lecidea leucothallina* Arnold, and *Porpidia contraponenda* (Arnold) Knoph & Hertel, as new additions to the Arctic flora of the Svalbard archipelago. Morphological and chemical descriptions are provided of these species based on the specimens collected from Svalbard, and we consider their global distribution.