OLIVINE PETROFABRICS OF UNGROUPED OLIVINE-RICH ACHONDrites
NORTHWEST AFRICA 6077, NORTHWEST AFRICA 6962 AND NORTHWEST AFRICA 13446.
T. Mikouchi¹, A. Takenouchi², D. Abe¹, A. Yamaguchi³ and A. J. Irving¹, ¹University Museum, University of Tokyo,
Hongo, Tokyo 113-0033, Japan (E-mail: mikouchi@um.u-tokyo.ac.jp), ²National Inst. of Polar Res. (NIPR),
Tachikawa, Tokyo 190-8518, Japan, ³Dept. Earth & Space Sci., University of Washington, Seattle, WA 98195, USA.

Introduction: Recent recovery of NWA meteorites includes several ungrouped olivine-rich rocks clearly
distinct from the brachinitic clan on O-Cr-Ti stable isotopic compositions, suggesting the presence of unknown differen-
tiated bodies from both CC and non-CC reservoirs [e.g., 1]. The formation of olivine-rich rocks is related to a prob-
lem suggested in [2] as “great dunite shortage” and it is important to assess their formation processes [e.g., 3]. In this
abstract we report olivine petrofabric analysis on three ungrouped achondrites NWA 6077, NWA 6962 and NWA
13446, each showing distinct O-Cr-Ti isotopic ratios. NWA 6077 is paired with NWA 5400 which has a terrestrial
Δ17O, but other isotopic anomalies are distinct from terrestrial values [e.g., 4]. NWA 6962 is a possible cumulate
from a CR partial melt [5]. NWA 13446 was recovered most recently among three samples studied and its O-
isotopic data and olivine compositions are close to H and L chondrites [6]. Therefore, studying these ungrouped
achondrites is important to better understand petrogenetic diversity of differentiated bodies in the early solar system.

Samples and Methods: Thin sections of NWA 6077, NWA 6962 and NWA 13446 were analyzed to obtain
electron back-scattered diffraction (EBSD) patterns of olivine using JEOL JSM-7100M FE-SEM at NIPR. The ob-
tained distributions of olivine crystallographic axes were analyzed with AZtec software. The employed space group
of olivine is P6mm (orthorhombic, a=4.8 Å, b=10.2 Å, c=6.0 Å, α=β=γ=90°).

Results and Discussions: NWA 6077 is mainly composed of homogeneous olivine (Fa30±20, ~1 mm) associated
with ~20% of slightly larger Ca-poor and Ca-rich pyroxenes (En75±7Wo2 and En74±6Wo24.4~2 mm), chromite and
Fe-Ni metal. The EBSD analysis of NWA 6077 olivine shows a strong crystallographic preferred orientation (CPO)
as is expected from its shape preferred orientation (SPO) (287 crystals, M index: 0.093, Fig. 1). The concentration of
CPO is found along b axis and a-c axes are randomly distributed perpendicular to b axis. The b axis concentration
of olivine is known for some brachinites and the most plausible mechanism is accumulation at the bottom of magma
chambers [3,7]. However, as observed for olivine in numerous terrestrial mantle rocks, rheological deformation can
also concentrate b axis by activation of the relevant olivine slip system and this could be the case for NWA 6077 olivine
since its geochemistry is consistent with a restite after chondritic partial melting and extraction of silicate melt [4].
NWA 6962 is composed of ~90% equant olivine grains (Fa45±6, ~2 mm) with interstitial intergrowth of pyroxene and
plagioclase. The EBSD analysis of NWA 6962 olivine does not show any clear preferreid crystallographic orientation
(238 crystals, M index: 0.064). Because NWA 6962 is suggested to be an olivine cumulate from a CR partial melt [5],
the absence of CPO indicates that olivine accumulation did not take place under a calm environment. NWA 13446 con-
stitutes ~80% zoned olivine (Fa16±2, ~0.5 mm) with interstitial pyroxene and glassy feldspar. Similar to NWA 6962,
NWA 13446 olivine does not show CPO of olivine (308 crystals, M index: 0.065). Because the texture of NWA
13446 implies an olivine cumulate origin, its formation condition would have been similar to that of NWA 6962.

Thus, we further found diverse formation mechanism of olivine-rich rock from differentiated bodies. The first find-
ing of a possible deformation process in the NWA 6077 parent body is especially significant.

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