**OXYGEN ISOTOPE AFFINITIES BETWEEN ALLENDE CV3 CHONDRULES AND THE EAGLE STATION PALLASITE GROUP PLUS SOME UNGROUPED ACHONDRITES: IMPLICATIONS FOR THE COMMON PARTIALLY DIFFERENTIATED PARENT BODY.**
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**Introduction:** Half a century ago in Mexico, the Allende meteorite was recovered in large quantities (over 100 kg) when a huge fireball hit the Earth and is known to be the most studied meteorite in history. The Eagle Station (ES) pallasite group has recently grown to 5 members following the discovery of Karavannoe [1] and Oued Bourdim 001 [2]. In this abstract, the oxygen isotope compositions of various chondrule types (e.g., PO, POP, BO, PP) in the Allende CV3 carbonaceous chondrite [3] are compared with the data of ES pallasites [1-2, 4] and recently found ungrouped carbonaceous achondrites (e.g., NWA 8186 [5] and NWA 7822 [6]). Clear geochemical [7-8] and isotopic [7, 9] similarities between CV and CK and their petrological analysis [10] have been identified as they belong to a common parent body [11]. Furthermore, paleomagnetic studies have recently suggested that the parent body of CV might have been partially differentiated [12-13]. It was proposed that the ES group could have derived from a distinct parent body based on the O [4] and Ni [14] isotope signatures. Until Karavannoe [1] and Oued Bourdim 001 [2] were discovered, it was also suggested that the ES trio be derived from the differentiation of CV (oxidized), CO or CK chondrites on the basis of siderophile elements [15].

**Samples and Analytical Methodology:** Acid-leached olivine grains of Eagle Station, Itzawisis and Cold Bay were analyzed using methods mentioned elsewhere [16]. Briefly, we used a 25W $CO_2$ laser (Merchantek, Bozeman, MT, USA; Model MIR10-25) equipped with a fluorination vacuum line. A custom-designed sample holder was adopted at the Laboratory for Stable Isotope Science (LSIS), Western University, Canada, to extract oxygen gas from olivine grains. Later, Delta V Plus mass spectrometer was used to measure pure oxygen gas for isotopic ratios. Our system provided an external precision of ±0.04‰ in $\delta^{17}$O and ±0.08‰ in $\delta^{18}$O values [16].

**Results and Discussion:** The O-isotope compositions (multiple runs; n = 2-9) of ES pallasites (5 members) and ungrouped achondrites (UA; 6 members having $\Delta^{17}$O < -3‰) are plotted (ESUA line; slope = 0.92, $R^2$ = 0.87) and compared to the Allende CV3 chondrules (ABC line; slope = 0.86, $R^2$ = 0.98; Fig. 1). Data of these meteorite types (i.e., ES, UA, and Allende CV3) overlap and fall between the PCM (slope = 0.99; [17]) and CCAM (slope = 0.94; [18-19]) lines (Fig. 1). There appears to be a comparatively greater scatter in the UA data, with few data points falling on the PCM line and some falling below the CCAM line (Fig. 1). Data from ES and UA occupy two separate areas of the plot and they are ~1‰ apart in their $\delta^{18}$O compositions (Fig. 2). UA reveal relatively heavier values of their bulk materials than those of ES olivine grains. The line's cumulative slope, referred to as the ESUA line, is 0.92 and 0.91 respectively from different runs of UA and ES (Fig. 1) and their average values (Fig. 2). ES group data alone, however, fit tightly onto a line with a relatively shallow slope (0.76; $R^2$ = 0.96, Fig. 2). ABC and ESUA lines crosscut at $\delta^{18}$O = -0.3‰ and $\delta^{17}$O = -3.5‰ in the middle of the UA data range (Fig. 2).

According to [3], ABC line defines a mixing trend between the anhydrous (i.e., primary) and hydrous (i.e., secondary) phases of Allende CV3. This also means that the parent body of Allende may have been influenced by various degrees of aqueous alteration and thermal metamorphic conditions. They estimated the temperatures that occurred on the Allende parent body for aqueous alteration (10-130 °C; mean ~60 °C) and thermal metamorphism (>150 °C and <600 °C). CV chondrite parent body has recently been proposed to have heterogeneous fluid-rock interactions at moderate temperatures (i.e., 210-610 °C; [20]).

Previously, O-isotope compositions of ES trio (e.g., Eagle Station, Cold Bay, Itzawisis) were assessed as the ES group plausibly belonging to a differentiated and isotopically homogeneous parent body [4]. The Ni isotope data [14] also supports this interpretation. Nevertheless, the oxygen isotope data from latest ES members (i.e., Karavannoe, Oued Bourdim 001) plotted together with other members from [4] yielded a best-fit line with slopes of 0.70 and 0.76 (Fig. 2) constructed for multiple runs and average values respectively. This indicates that the parent body of ES may not have achieved the isotopic homogeneity due possibly to insufficient heating from sources like $^{26}$Al decay and impact events. Recently, however, it was suggested that both heating sources were involved in the extensive melting and differentiation that created the Karavannoe in its parent body's deep interior [1]. In addition, geochemical and oxygen isotope signatures indicate that it was probably originated from materials close to CV3

[1]. Furthermore, the $^{54}$Cr data of silicate and oxide from the ES pallasite showed that both phases derived from a common Cr reservoir and the impact-related presence of a separate Cr source is unlikely [21].

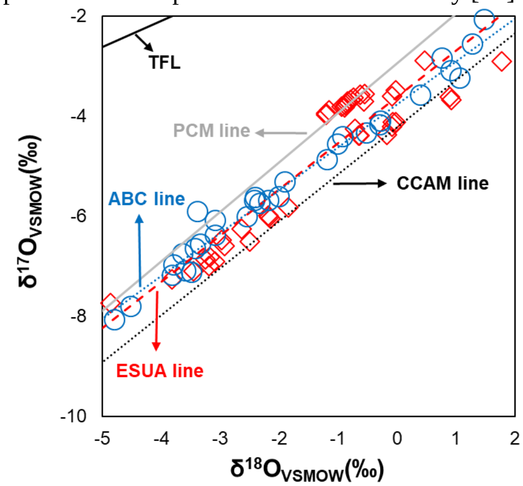


Fig. 1. Plot of O-isotopes of ES pallasites and ungrouped achondrites (red diamonds; multiple runs; data sources: [1-2, 4, 13, 22-24]) and Allende CV3 chondrules (blue circles; [3]). TFL = Terrestrial fractionation line. PCM = Primitive chondrules mineral. ABC = Allende bulk chondrules. ESUA = Eagle station ungrouped achondrites. CCAM = Carbonaceous chondrite anhydrous mineral.

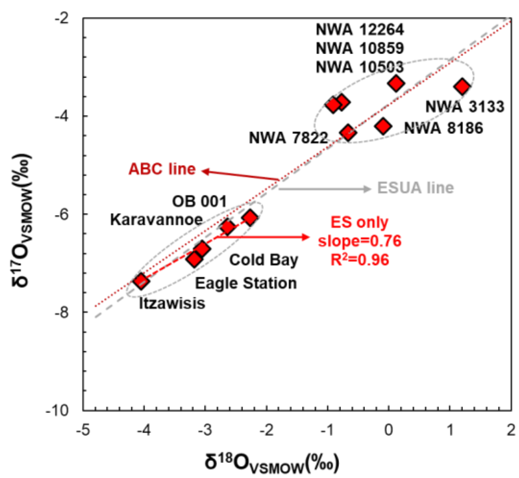


Fig. 2. Triple O-isotope plot of ES and UA compositions (average data). Red-dotted line represents the ABC line (slope = 0.86) yielded by the data of various chondrule types from Allende CV3 chondrite [3]. Gray-dashed line passes through the data of ES and UA (ESUA line). Red-dashed line represents the data of ES group alone (slope = 0.76). OB=Oued Bourdim. Data sources: [1-2, 4, 13, 22-24].

Oxygen isotope data of chondrules from Allende, ESs and UAs clearly show that a genetic link exists between them (Fig.1-2). Recently, it has been reported that it is useful to use $\Delta^{17}$O-$\varepsilon^{54}$Cr parameters for the identification of common sources for different meteorite types [25-27] instead of using the O-isotopes data alone. Currently available $^{54}$Cr data from Allende [9], ES [21] and UAs [26-27] are indistinguishable within uncertainty limits, but we suggest that a detailed study of $^{54}$Cr isotopes be carried out to confirm that the trio may have originated from a specific parent body. Given together, we also say that the parent body may have differentiated partially because of inadequate heating that left the unstratified crust (e.g., Allende), a mantle (e.g., UAs) and the core-mantle boundary (e.g., ESs). However, variable slopes (<1 and >1/2) yielded by different parent body components indicate that O-isotope signatures do not display entirely mass-independent (slope-1) or mass-dependent (slope-1/2) trends. This may have been triggered shortly after the start of our Solar System by the low temperature secondary processes on an asteroid parent body after its accretion.

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