ON THE AGE OF THE NECTARIS BASIN. R. L. Korotev, J. J. Gillis, L. A. Haskin, and B. L. Jolliff, Department of Earth and Planetary Sciences, Washington University, Saint Louis MO 63130 (rlk@levee.wustl.edu)

We do not know which, if any, rocks of the Apollo collection record the age of the Nectaris impact. However, the age of Nectaris is generally accepted (e.g., [1,2]) to be 3.92 Gyr on the basis of the careful analysis of breccia ages by James (1981, [3]). In essence, the argument is based on the following observations and assumptions, among others. Of the Apollo sites, Apollo 16 lies closest to the Nectaris basin, but Imbrium is bigger and its deposits overlie some Nectaris deposits because it's older. Nevertheless, from ejecta deposit modeling, "most of the material at the Apollo 16 site should have Nectarian or pre-Nectarian ages" [3], i.e., it would predate Imbrium. Granulitic breccias are common at the site. Although it is not known in which basin or crater they formed, they are not likely products of the Imbrium impact, and their measured ages would not likely be affected by the Imbrium impact. They are also not likely products of post-Nectarian, pre-Imbrian impacts that formed local craters. Their ages, therefore, provide an upper limit to the Nectaris age. Most granulitic breccias, and most materials of the Apollo 16 site, have 3.9 Gyr ages (Fig. 1), so this age likely corresponds to a basin, probably Nectaris. Because of certain textural features, the apparent old ages of the feldspathic fragment-laden melt breccias (Fig. 1) "may not have any chronologic significance" [3].

We review some recent data, observations, hypotheses, models, and opinions. (1) It is not self-evident that the geochronologic data provide a precise date for any event (Fig. 1). (2) New ejecta deposit modeling suggests that Serenitatis, which also post-dates Nectaris, strongly influenced the site [4]. Thus, Apollo 16 granulitic breccias are as likely to record the age of Serenitatis as Nectaris. (3) Although most Th-rich Apollo 16 rocks have 3.85–4.0-Gyr ages, there is no evidence from Lunar Prospector data [5] that Th-rich material was encountered or excavated by the Nectaris impactor. All or most of the Th-rich breccias of the Apollo 16 site likely derive from the Procellarum KREEP Terrane [6,7]. (4) In a popular model of the Apollo 16 site geology, an Imbrium ejecta deposit, the Cayley Formation, overlies a Nectaris ejecta deposit, the Descartes Formation, and the North Ray Crater (NRC) impactor penetrated the Cayley to exhume and deposit Descartes material at the surface [e.g., 2]. However, our preliminary inspection of data from Lunar Prospector [5] and Clementine [9] indicate that in the vicinity of the Apollo 16 site there is no significant compositional distinction at the surface between the Descartes and Cayley Formations. (5) Feldspathic fragmental breccias, a characteristic lithology of NRC, are identified as a likely Descartes component [8]. In addition to clasts of granulitic breccia, they contain contain clasts of Th-rich impact-melt breccia; the only such clast measured is 3.9 Gyr in age [10]. Thus, the feldspathic fragmental breccias of NRC may be constituents of a heterogeneous ejecta deposit from Imbrium, not Nectaris. (6) There is no evidence in the Ar isotopic data for Apollo 16 impact-melt breccias ("other…," Fig. 1) that the Cayley Plains and NRC ejecta sampled basin deposits of a different ages or that KREEP-rich and non-KREEP-rich breccias sampled basin deposits of different ages.

In combination, these issues suggest that the NRC impactor did not penetrate the Cayley Formation and excavate Descartes Formation and that few if any Apollo 16 rocks record the age of Nectaris. Thus, Nectaris may have formed earlier than 3.9 Gyr ago, perhaps at 4.1 Gy [11,12]. Ages of ~3.9 Gyr may approximate the age of Imbrium or Serenitatis or "may not have any chronologic significance."

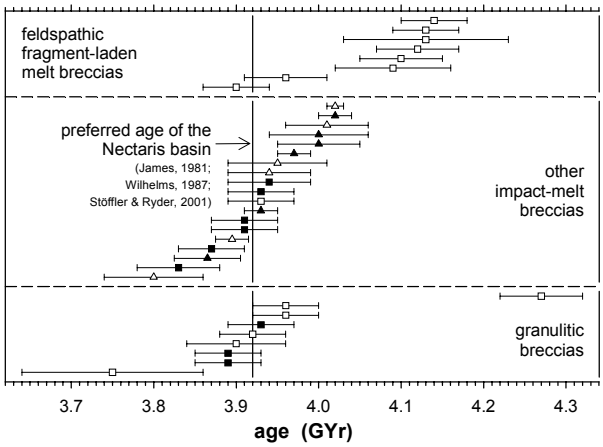

Figure 1. Whole-rock ^{40}Ar-^{39}Ar ages of Apollo 16 breccias with ages >3.6 Gyr. Squares represent samples from stations 11 and 13 (North Ray Crater); triangles represent all other stations (Cayley Plains). Filled symbols represent samples with compositions like melt groups 1 and 2 of [6] and which, consequently, are likely to be mafic and contain a large proportion of KREEP (>3 µg/g Th). Unfilled symbols represent samples with like melt groups 3 and 4 of [6] and which are likely to be feldspathic with little or no KREEP. Data are from the compilations of [2] and [3], which include only ages derived from "good" plateaus and which have been corrected to decay constant of [13]. For data from the lab of O. Schaeffer, we assume correction procedure of [3] to be more valid that that of [2]. For the few samples for which more than one age is available, the error-weighed mean is plotted. Each point represents a different sample.

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