Introduction
12039 was termed a graphic ilmenite-bearing gabbro by James and Wright (1972) and pigeonite basalt by Rhodes et al. (1977) and Neal et al. (1994). The sampling location of 12039 is not known. It is rounded and has zap pits that are hard to see. It has been dated at 3.2 b.y.

Petrography
McGee et al. (1977) describe 12039 as “a coarse grained porphyritic basalt which consists of pyroxene phenocrysts (0.8 to 4 mm), some of which are mantled by pyroxferroite, set in a matrix of intergrown plagioclase tablets (0.8 - 2 mm), anhedral pyroxene, rounded laths of ilmenite (0.8 – 2 mm) and euhedral laths of tridymite (0.05 to 1 mm)”. Bunch et al. (1972) describe 12039 as a “micrograbbro, with variable texture ranging from subophitic to granular, and occasionally clinopyroxene grains are poikilitically enclosed by plagioclase”.

Long needles of ilmenite and tridymite cut across plagioclase and pyroxene (figure 2).
Mineralogy

Olivine: none

Pyroxene: Pyroxene analyses for 12039 are given by Bunch et al. (1972) and McGee et al. (1977) (figure 4). According to Bunch et al. (1972), many of the clinopyroxene crystals show optical zonation from very light tan interiors (augite) to dark tan (ferroaugite) to redish-brown (ferrohedenbergite) with an abrupt change to light yellow-green borders (pyroxferroite).

Plagioclase: Plagioclase is An$_{93}$ to An$_{82}$ (Bunch et al. 1972).

Opaque: Ilmenite is the major opaque phase and is intergrown with ulvöspinel. Tranquillityite, troilite and native iron blebs are present in the mesostasis.

Silica: Bunch et al. (1972) analyzed both tridymite and cristobalite in 12039.
Tranquillityite: Lovering et al. (1971) give the analysis of tranquillityite in 12039.

Chemistry
Rhodes et al. (1977) and Nyquist et al. (1977) determined the composition of 12039 (figures 5 and 6). It has the highest Fe/Mg ratio of the Apollo 12 basalts.

Radiogenic age dating
Nyquist et al. (1977, 1979) determined the Rb-Sr age as $3.19 \pm 0.06$ b.y. (figure 8) and a concordant age of $3.2 \pm 0.05$ b.y. by Nd-Sm (figure 7).

Cosmogenic isotopes and exposure ages
O’Kelly et al. (1971) reported the cosmic-ray induced activity to be $^{22}$Na = 43 dpm/kg, $^{26}$Al = 95 dpm/kg, $^{54}$Mn = 37 dpm/kg and $^{56}$Co = 40 dpm/kg.

Processing
12039 was cut with a band saw (figure 10). It has been used for public display (figure 9). There are 8 thin sections.

Mineralogical Mode of 12039

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### Table 1. Chemical composition of 12039.

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Technique: (a) INAA, (b) IDMS, (c) XRF, (d) radiation counting, (e) electron microprobe

### List of Photo #s for 12039

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Figure 7: Sm-Nd mineral isochron diagrams for 12039 and 12056 (Nyquist et al. 1979).

Figure 8: Rb/Sr isochron diagrams for selected Apollo 12 samples inc. 12039 (Nyquist et al. 1977).

Figure 9: 12038.0 on display. NASA #S70-17703.

Figure 10: Bandsawing 12039. NASA #S76-21578.

Summary of Age Data for 12039

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Lunar Sample Compendium
C Meyer 2011
References for 12039


