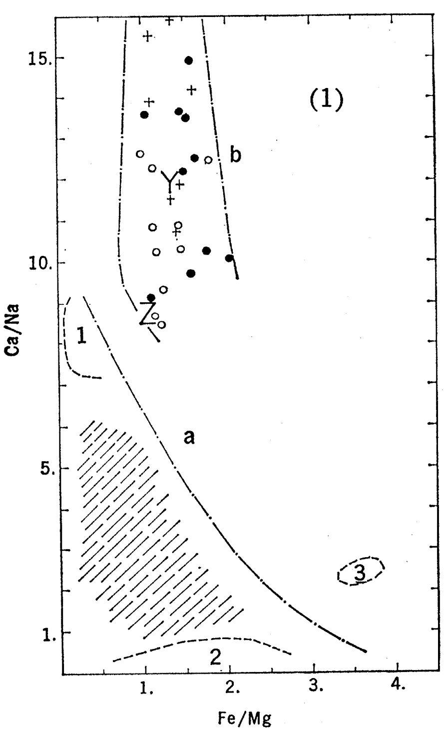

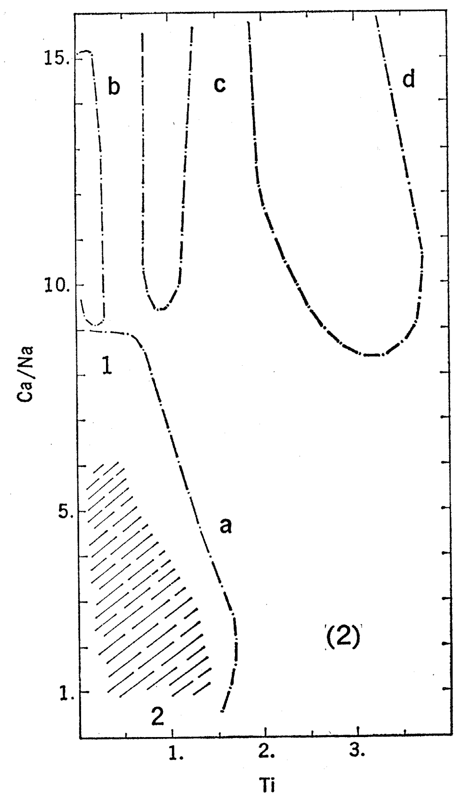

Fig. 1 (left). Atomic ratios (Ca/Na plotted against Fe/Mg). (a) Terrestrial igneous common rocks (basalts, andesites, and most basic and ultramafic rocks) fall in hatched area. Some special types (eclogite blocks, madupites, ankaratrites) cluster around area 1; feldspathoidal rocks cluster around area 2; and certain iron-rich tholeiitic differentiates (mainly pegmatoid) cluster around area 3. (b) Lunar samples (Apollo 11): (open circles) data from (*4*); (crosses) data from (*5*, *6*). (Filled circles) Selected eucrite meteorites. Lunar samples from Apollo 12, not shown individually, are spread throughout the same field (*7*). *Y*, alpha-scatter data from Surveyor 5, Mare Tranquillitatis (*3*); *Z*, alpha-scatter data from Surveyor 6, Sinus Medii (*3*). Fig. 2 (right). Atomic ratio, Ca/Na plotted against Ti (atomic percentage), for same rocks as in Fig. 1. (a) Values for most terrestrial igneous rocks fall in the hatched area. (b) Eucrites; (c) Apollo 12 samples; and (d) Apollo 11 samples. Compositions 1 and 2 have the same significance as in Fig. 1.

tually distinct areas. In the field of terrestrial rocks high values of Ca/Na are invariably associated with low values of Fe/Mg. In the field of lunar rocks and eucrites both ratios are consistently high. Plots of other chemical parameters, for example, Ca/Na against Ti (Fig. 2), likewise reveal consistent chemical differences between terrestrial and nonterrestrial rocks (and also between lunar rocks sampled to this date and eucrite meteorites). The strong vertical dispersion of points for high Ca/Na values of nonterrestrial rocks merely reflects variation in uniformly low Na values, either real or perhaps within the range of analytical precision. This dispersion, which has no fundamental significance, would vanish on a semilogarithmic plot.

Collectively, the chemical data plotted in Figs. 1 and 2 preclude identification of lunar and meteoritic rocks with familiar terrestrial rock types such as basalt and gabbro which they may, however, resemble texturally and to some degree mineralogically. Indeed, although some contributors to recent literature on lunar rocks persist in employing the standard nomenclature of petrology, some have stressed, on other chemical grounds than those stated above, the fundamental difference that appears to mark the separate identities of terrestrial and extraterrestrial rocks (*6*). Perhaps it is already time for those working in the field to consider setting up a suitable nomenclature for lunar rocks.

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References and Notes

1. F. Turner and M. Ulbrich, *Proc. Nat. Aacd. Sci. U.S.* **64**, 1016 (1969).
2. The parameter (Ca + K)/Na is useful in interpreting alpha-scatter data, which provides no means of distinguishing Ca from K.
3. E. J. Franzgrote, J. H. Patterson, A. L. Turkevich, T. E. Economou, K. P. Sowinski, *Science* **167**, 376 (1970).
4. Lunar Sample Preliminary Examination Team, *ibid.* **165**, 1211 (1969).
5. J. A. Maxwell, S. Abbey, W. H. Champ, *ibid.* **167**, 530 (1970); L. C. Peck and V. C. Smith, *ibid.*, p. 532.
6. A. E. J. Engel and C. G. Engel, *ibid.*, p. 527; H. B. Wiik and P. Ojanpera, *ibid.*, p. 531.
7. Since this note was submitted for publication, preliminary analyses of lunar samples from Apollo 12 have become available [table 2 in Lunar Sample Preliminary Examination Team, *Science* **167**, 1325 (1970)]. These data are shown in Figs. 1 and 2.
8. Supported by NSF grant GA 10636. I thank Professor F. J. Turner for valuable suggestions and for reading the manuscript.

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Heavy Carbon

The statement that "the $\delta^{13}C$ data [+13 to +18.5 per mil relative to the PDB isotope standard] demonstrate that the carbon measured in these two [lunar surface] samples is definitely nonterrestrial since such positive values have never been found on earth" (*1*) is incorrect. The heaviest naturally occurring terrestrial carbon known occurs in ultramafic igneous rocks and has a $\delta^{13}C$ value as high as +24.8 per mil with respect to the PDB standard CO_2 (*2*).

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References and Notes

1. J. Oró, W. S. Updegrove, J. Gibert, J. McReynolds, E. Gil-Av, J. Ibanez, A. Zlatkis, D. A. Flory, R. L. Levy, C. Wolf, *Science* **167**, 765 (1970).
2. P. Deines, *Geochim. Cosmochim. Acta* **32**, 613 (1968).

11 February 1970

In condensing the original manuscript (*1*) the meaning of the sentence was unfortunately changed. We apologize and thank Dr. Weber for his indication. In our expanded paper (*2*) the sentence has been clarified and mention is made that such positive values have only been found on earth in some types of carbonates. The point is that the measured values are not the result of terrestrial contamination.

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References

1. J. Oró, W. S. Updegrove, J. Gibert, J. McReynolds, E. Gil-Av, J. Ibanez, A. Zlatkis, D. A. Flory, R. L. Levy, C. Wolf, *Science* **167**, 765 (1970).
2. J Oró, W. S. Updegrove, J. Gibert, J. McReynolds, E. Gil-Av, J. Ibanez, A. Zlatkis, *Geochim. Cosmochim. Acta*, in press.

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