MARE BASALT DEPTHS FROM ORBITAL X-RAY DATA. C. G. Andre*, R. W. Wolfe**, I. Adler* and P. E. Clark*. *University of Maryland, College Park, MD 20742. **Smithsonian Institution, Washington, D. C. 20562.

Since the Apollo missions to the Moon, estimated values for mare basalt depths have become progressively smaller (from tens of kilometers to tenths of kilometers) as new indirect approaches to the problem were applied. The limitations of each of these indirect methods makes it necessary to combine results and seek new ways to evaluate them. Orbital X-ray data from impact craters at a few specific locations provide still another means for estimating mare depths.

The X-ray experiment detects chemical changes in surface soils only. However, material ejected from an impact crater is deposited beyond the rim in an inverted order so that material from the lowest strata in the crater is closest to the surface. For this reason, material at depth within a crater too small to be resolved by this experiment becomes visible because of the lateral extension provided by the ejecta. The degree to which orbital X-ray intensity ratios can resolve such a chemical feature is a function of both its size and chemical contrast to the adjacent surface (Fig. 1).

Some impact craters can be used to limit estimates of mare basalt depths. For instance, the maximum thickness of mare basalts may be inferred from the depths of impact craters which, according to our measurements, have excavated terra material from beneath the mare. These craters exhibit the chemical characteristics of terra material which surrounds and underlies mare

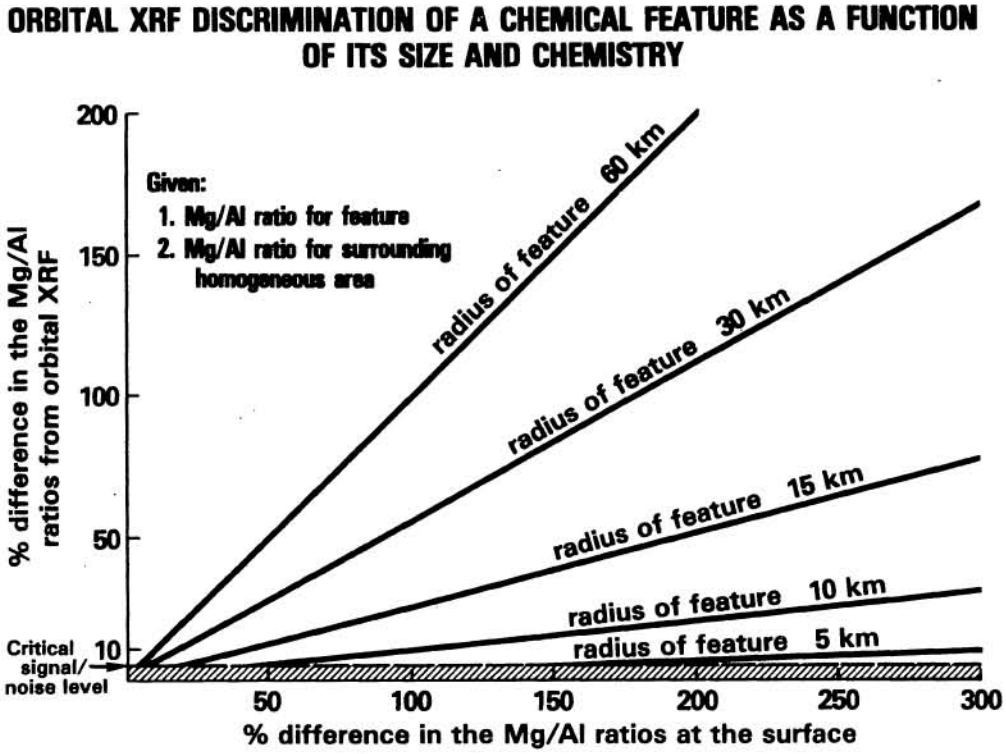

FIGURE 1

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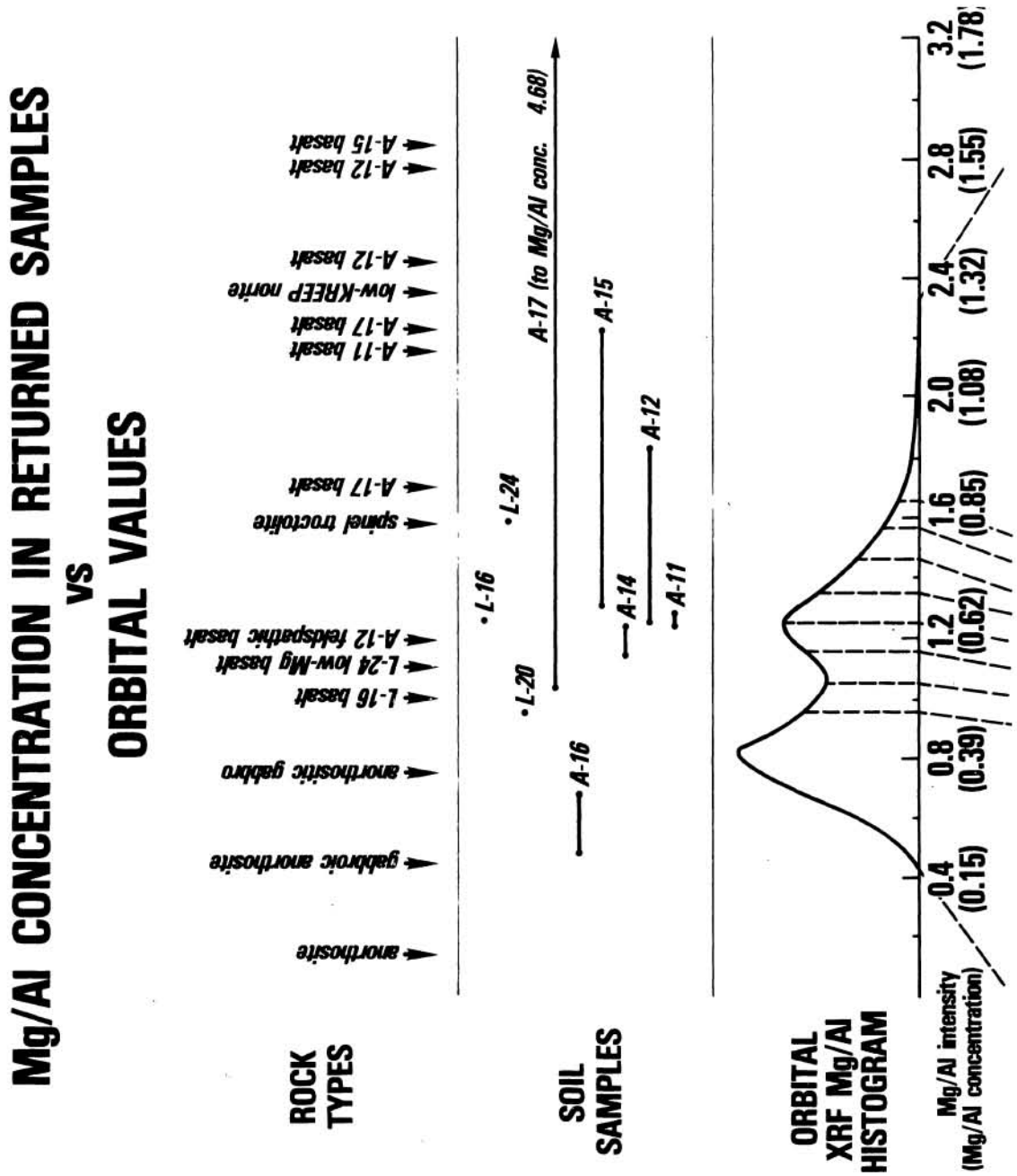
FIGURE 2



basalt accumulations in nearside basins. Mg/Al ratios are particularly useful for identifying these craters because the concentration of magnesium and aluminum vary inversely for mare material (high Mg/Al) vs terra material (low Mg/Al) (Fig. 2). Variations due to a terra component within the mare are accentuated by the dynamic range of this ratio which exceeds that of Al/Si or Mg/Si.

Other impact craters within the maria have higher Mg/Al ratios than the surrounding soil. This suggests that a subsurface layer of a different basalt composition has been excavated. In this instance, we may infer 1) that the interface between these two chemically different basalt types lies at depths less than that of the crater and 2) that the total accumulation of basalts in this area exceeds the depth of the crater (i.e., the ratios are not representative of terra material from the basin floor). Four craters illustrate this situation. The impact craters Peirce and Picard in Mare Crisium have extremely high Mg/Al ratios relative to the surrounding surface soils. These data indicate that a magnesium-rich subsurface basalt was excavated from depths less than 1490 m and 1750 m respectively and that the total thickness of basalts at Peirce and Picard exceeds their respective depths. Similarly, high Mg/Al ratios associated with the overlapping continuous ejecta of the craters Messier and Messier A in northern Fecunditatis indicate that basalts with a higher content of magnesium than adjacent surface basalts lie at depths less than 1700 m. (See also a companion abstract by Andre et al. in this volume.) From these ratios it may also be deduced that basalt thickness at this location in Mare Fecunditatis exceeds 1700 m.

X-ray data at impact craters which have excavated 1) terra-type material from beneath the mare and 2) basalts of a different (non-terra) composition from depth have been used to construct the following table of limitations on basalt thickness at specific locations. None of these estimates are inconsistent with isopach maps by DeHon (2,3). These features may be seen on color images of Mg/Al ratios corrected for solar induced interorbit variation (4,5) which will be displayed in the exhibit hall during the conference.

Basin	Feature	Location	Mare depth (m)
Serenitatis	Catina Littrow	29°30'E;22°10'N	< 500
Tranquillitatis	Plinius	23°35'E;15°20'N	< 2000
	Ross	21°45'E;11°40'N	< 1800
	Cauchy	38°37'E;9°35'N	< 1600
Fecunditatis	Messier	47°37'E;1°55'S	> 1500
	Messier A	46°55'E;2° 3'S	> 1700
Crisium	Yerkes E	50°40'E;15°55"S	< 1100
	Peirce	53°27'E;19°20'N	> 1490
	Picard	54°47'E;14°30'N	> 1750

Acknowledgments--This work was supported by NASA grant NGR-21002-368.

REFERENCES

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