Maps (1:1 000 000) and other contour maps are used as base maps. The contours of each map chosen are digitized at designated intervals. For this study the assumption is made that lava sources are ubiquitous; thus flooding begins at the lowest point on the map, flooding evenly to each new contour level, and begins in separate isolated depressions as the rising lava first encounters the appropriate contour within the depression. Flooding continues until all topography disappears. Lava thickness as a function of area and volume are plotted, and maps of any stage of flooding can be produced by Calcomp plots of the digitized topographic data. Data reduction techniques are described in Appendix A.

One of the major difficulties in determining volcanic deposit thicknesses in many lunar maria is the fact that the deposits occupy relatively young lunar basins. The relative youth of the basins means (1) that there are fewer post-basin craters that can be used to determine basalt thickness by conventional methods, and (2) that the geometry of the young basins is sufficiently deep so that many craters are completely covered. The purpose of this paper is to report on the artificial flooding of two basin-related areas in order to obtain thickness and volume estimates for multi-ringed basins flooded by mare deposits.

The major topography of young multi-ringed basins, as revealed by the relatively unflooded Orientale basin (Moore *et al.*, 1974; Head, 1974b; Head *et al.*, 1975; Howard *et al.*, 1974; Head *et al.*, 1981) consists of an inner depression and rough topography comprised of basin rings and associated facies within the major scarp defining the basin (the Cordillera Mountains for Orientale) (Figures 3, 4a). Some basins are flooded out to the outer scarp (Imbrium, in many places, for example; Wilhelms and McCauley, 1971), others are flooded only to the major second ring (Serenitatis [Head, 1978]), while others are flooded primarily in the inner depression (Orientale [Greeley, 1976] and Nectaris). Two separate areas are treated here: the *Orientale basin*, and the *Archimedes–Apennine Bench region* which represents the region between the second and third basin rings in Imbrium.

2. The Orientale Basin Example

Topography for the Orientale basin was derived from a series of limb profiles (Watts, 1963) and is consistent with topography determined from other sources (Head, 1974b; Howard *et al.*, 1974; Brown *et al.*, 1974; Kaula *et al.*, 1974). A topographic map of Orientale was produced using the Watts limb measurements and contouring the data points for elevations (Head *et al.*, 1981). Data exist for only slightly over half the basin; this topography was assumed to be characteristic of the rest of the basin and the values in Figures 4e, f reflect flooding of the whole basin. Since the basin interior is known to vary in morphology from east to west (Moore *et al.*, 1974), actual topographic data from the west would undoubtedly modify details of the curves, but the general shapes would very likely remain the same. The interior of Orientale (Figure 4a) contains maria perhaps up to one km thick (Head, 1974a; Greeley, 1976; Scott *et al.*, 1977) and several thinner patches of maria at the base of the second and third rings (Greeley, 1976; Gaddis and Head, 1981).