CONSTRUCTION OF DIGITAL AND PHOTOMOSAICS OF GANYMEDE; R. Philpott, V. Moore, D.A Godfrey, N.Baker, Dept. Space Physics, Imperial College, London SW7 2BZ.

Introduction - Two mosaics, in a Mercator and polar stereographic form and covering the area of Ganymede imaged by the Voyager 2 spacecraft were made for a geological and structural mapping project and as a basis for a tectonic study. The mosaics were compiled using digital images which required pre-processing, navigation, map-projecting and mosaicing with much of this process requiring the active intervention of the user.

Image Selection - A total of 113 clear filter images were selected which had suitable resolutions for a geological study, i.e., 0.5 to 2 km/pixel. These Voyager 2 images cover over a third of the moon's surface including the equatorial and south polar regions between latitude -90° to +65° and longitude 110° to 255°, with highest resolution images at the south pole. The criteria used for the selection were: 1. Maximum coverage of the satellite's surface at resolutions suitable for a geological study. 2. The highest resolution images were used for each area with the lower resolution images filling in gaps. 3. Each image would need to be fully navigable.

Image Processing - The images were radiometrically and geometrically corrected using standard Voyager processing routines. Navigation of the images was accomplished by obtaining 3 rotation matrices (1), which provide the basis for converting from cartographic co-ordinates in object space to camera co-ordinates in image space, i.e. converting the lat. , long. of a point on the moon's surface to its position in line, sample on the perspective image.

Map-projecting - Map-projecting the images requires navigation of the satellite together with appropriate map-projection formulae which convert lat.,long. to line,samp for the Mercator and polar stereographic projections (2). The images were map-projected to scales of 1 km/pixel and 0.5 km/pixel for the Mercator and polar stereographic respectively. Because the images comprise a heterogenous data set with differing resolutions, angles of view and contain full field and limb views, the images alter in both size and shape on projection. The output resolutions were selected by experimentation using a wide range of images. It was important to reduce the loss of contrast within the images which occurs when their output size is increased too much, as this requires the infill of the additional pixels by averaged values from neighbouring data. The images were also map-projected relative to selected special reference tiepoints so that a given lat. long. co-ordinate is tied to its equivalent output line, sample in the map-projected image.

Map-projection charts - The distribution of the images relative to the surface of the moon was not known, so two charts were produced which displayed the outlines of the map-projected images in their correct geographic locations to show their coverage. This was accomplished by reversing the navigation and map-projecting routines so that a (line,samp) in a perspective image could be converted to (lat,long) and then to the map-projected (line,samp). A simplified version of the Mercator chart showing a few images over a small portion of the moon's surface is shown in Fig. 1. The image outlines showing jagged edges are limb images, the result of assuming Ganymede is a perfect sphere in

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the navigation routines (1). With these charts it was possible to select the lowest number and highest quality images which would be incorporated into each mosaic.

Mosaic Construction - The images were initially mosaiced together into small sub-mosaics. On each image a small, 3x3 pixel, feature was chosen and used as a tiepoint to tie images together. The line, sample position of the feature was found in both images and any brightness variation noted and corrected by multiplying the image pixel values by a suitable constant. Histograms of the images were made to check the levels of saturation. Prior to the mosaicing the quality of the overlap was also checked. Portions of images were removed where a large amount of overlap occurred, particularly where low resolution and high resolution images were being combined, since this reduced the image quality in the area of overlap. After mosaicing the resultant image was checked for quality and brightness equalization. Fifty-four and fifteen images were used to construct the 8909 lines by 7072 samples Mercator and 6018 lines by 4510 samples polar stereographic mosaics, respectively. Cartographic tick marks outlining the latitude and longitude grid were added.

Photographic Hardcopies - Prior to obtaining photographic negatives using an SERC funded Optronix unit at Rutherford Appleton Laboratory, the brightness range had to be reduced and the mosaics cut into smaller segments. The Mercator mosaic was divided into 6 smaller equal sized segments and the polar stereographic into 3. Enlarged positive prints 24x30 inch were made of each segment which were used for a later mapping project. The digital mosasaics were used for detailed investigations of areas of interest. The final scales of the photographic mosaics were 1:630,000 for the Mercator and 1:310,000 for the polar stereographic.

References

1. M.E. DAVIES et al. (1980). Co-ordinate features on the Galilean satellites. JPL/NASA, N1617.
2. D.A. ELLIOT et al. (1977). Transformations from an oblate spheroid to a plane and vise versa - The equations used in the cartographic projection program MAP2. JPL Publ. 77-7.

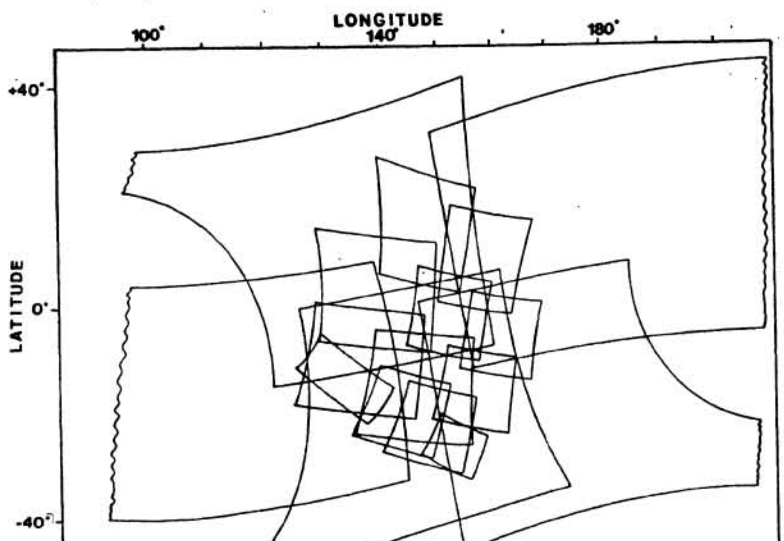

Fig. 1.