THE TECTONIC HISTORY OF GANYMEDE; R. Philpott, Dept. Space Physics, Imperial College, London SW7 2BZ, U.K.

Introduction - Following on from a geological, chronological and structural mapping project a proposed tectonic history for Ganymede was derived. This was based on detailed interpretation of the photographic hardcopy mosaics of approximately one-third of the satellite's surface imaged by Voyager 2 and statistical analyses of the structures mapped.

Mapping Summary - Six terrain units were identified and a basic chronological sequence established incorporating crater statistics (1) and geological observations. Mapping of the sulci indicated that specific age/trend relationships could be derived and that several episodes of tectonic activity were responsible for their formation. The sulci are envisaged as structural grabens which have been developed in extensional stress-regimes and later infilled by extrusive water-ice (2). Their formation is associated with the development of different terrain types, in particular grooved and intermediate terrain. The intermediate terrain is thought to result from ice overlying nearby tilted fault blocks of dark terrain towards the end of the infilling of a sulcus.

Results - By combining observations of the sulci cross-cut age/trend relationships from the mapping and interpreting associated structures in frequency/orientation plots, a complete chronology for the sulci trends was produced. It appears that three major episodes of tectonic activity have occurred. They have resulted in the formation of sulci with the following chronological trends, from oldest to youngest: B (310 - 320), A (290 - 300) and C (80 - 90) (Fig. 1). A further four episodes of more localized activity may have also occurred and these events, labelled I to IV are more limited in extent. Sulci II, III and IV tend to be smaller in size and are mainly confined to the southern hemisphere (Fig. 1). The geology in the south is more complex and this, together with the large proportion of smooth terrain which is a late re-surfacing event occurring after grooved terrain formation, suggests that the south area is younger than the north. The presence of a number of impact basins in the south, including the large Gilgamesh basin, may indicate that there is a relationship between these and smooth terrain formation. Large asteroid impacts may cause localized disturbances resulting in limited tectonic activity with water being extruded via the major boundary faults of suitably orientated sulci and infilling them with smooth terrain material.

References
The tectonic history of Ganymede is characterized by several episodes of activity. The oldest features are the furrows, which are radial fractures associated with the formation of the moon's history. The furrows are confined to the dark terrain and are limited in extent.

Conjugate fractures develop in an extensional stress regime and are re-activated in the north and south latitudes.

Particular fracture and furrow trends are re-activated by a series of different orientated extensional stress fields. These structures, which denote sites of crustal weakness, are used for sulci and basin formation.

Sulci I: First episode of sulci formation. Structures with an N-S orientation are activated in the north and south latitudes.

Sulci II: Major sulci development most prominent in the north. Furrow trends are re-activated and used for sulci formation. The Galileo Regio furrows are used for the formation of the large Dark Sulci.

Sulci III: Second period of major planet-wide sulci development; sulci occur in the north, south, and polar regions. This period of extensional tectonic activity has used old fractures trending NW-SE for sulci creation.

Sulci IV: These sulci, orientated NW-SE, are confined to the south and polar regions and represent the youngest of the major planet-wide sulci formation events.

Sulci V: Confined to the southern areas these sulci formed during a short period of time which did not allow their full development and are seen as small young sulci trending NE-SW. The smooth terrain is associated with this phase of activity.

Sulci VI: Limited to southern and polar areas, these minor sulci are also associated with phases of smooth terrain replacement. The smooth terrain material is thought to be fed via deep fractures in the grooved terrain.

Sulci VII: These are seen only in the polar area and their NE-SW trends are associated with smooth terrain replacement. Three phases of major sulci development (I, II, and III) may be connected with large asteroidal impacts causing surface activity rather than deep seated tectonic movements.

Basinal terrain is the youngest terrain type but the different basins are not necessarily the same age.