DESCRIPTION OF MAP UNITS
PLAINS MATERIALS

pvs   VERY SMOOTH PLAINS MATERIAL—Occurs as smooth level surfaces in floors of some c_4 craters. Few superposed craters at Mariner 10 resolution. *Interpretation:* Possibly shock melt and fallback associated with formation of each crater or adjacent crater; possibly young volcanic material

ps   SMOOTH PLAINS MATERIAL—Forms flat to gently rolling plains at the resolution of Mariner 10 (Trask and Guest, 1975). Occurs in annulus around Caloris Basin and also inside other apparently low, roughly circular areas, some of which are basins. Contains sinuous to lobate ridges, especially near Caloris. Surface covered by small bright-halo craters. Sharp overlapping contacts with older terrain. *Interpretation:* May consist of lavas formed as highly fluid melts; however, no volcanic vents or undisputed lava flow-fronts observed. Alternatively, may be shock-melt material

psi   INTERMEDIATE PLAINS MATERIAL—Forms flat to rolling plains in topographic depressions and around the edge of smooth plains material. Has fewer superposed craters than intercrater plains. Probably includes thin cover of unmapped Odin material (unit com). Boundaries poorly defined. *Interpretation:* May consist of volcanic material older than smooth plains material or may be shock-melt material.

pl   LINEATED PLAINS MATERIAL—Plains with lineated texture. *Interpretation:* May be ejecta from c_2 and pre-Caloris c_3 basins and large craters

pi   INTERCRATER PLAINS MATERIAL—Forms extensive rolling terrain between large c_1 and c_2 craters, especially to the east. High density of superposed 5- to 10-km-diameter craters, as well as elliptical craters similar in morphology to secondary craters (Trask and Guest, 1975). *Interpretation:* A plains unit consisting of degraded remnants of ejecta sheets associated with c_1 and c_2 craters

cfp   CALORIS FLOOR PLAINS MATERIAL—Closely resembles smooth plains material (unit ps) but shows more intense secondary deformation in the form of sinuous ridges and fractures, forming a grossly polygonal pattern. *Interpretation:* Uncertain: may be shock-melt material associated with Caloris impact or younger volcanic material

h   HILLY PLAINS MATERIAL—Relatively dark plains with hilly surface. Found outside range of most Caloris units but may be associated with ejecta from the Caloris event. Relatively few superposed craters. *Interpretation:* possibly ejecta from Caloris or from older craters and basins

BASIN MATERIALS
CALORIS GROUP

cm   Caloris Montes Formation—Consists of numerous rectilinear massifs as high as several kilometers that may be as much as 30 to 50 km across. Surface of massifs is rugged. Forms rim crest of Caloris Basin. Type area: Region near lat 18° N., long 184.5° W. in Tolstoj quadrangle (FDS 229) (McCauley and others, 1981). *Interpretation:* Uplifted prebasin bedrock veneered by late ejecta from Caloris. Inner boundary approximates limit of crater excavation

cn   Nervo Formation—Consists of patches of hummocky to rolling plains that lie topographically above both the plains of the Caloris floor (unit cfp) and the smooth plains material (unit ps) that surrounds Caloris Basin. Locally appears to be draped over subjacent blocks and massifs of Caloris Montes Formation (unit cm). Contact with Odin Formation gradational and difficult to map. Type area: region near lat 40° N., long 177.5° W. (FDS 193) and

south of unrelated crater Nervo (McCauley and others, 1981). *Interpretation:* Probably fallback mixed with impact melt

co   Odin Formation—Extensive but diffuse patches of hummocky plains that lie as far as 800 km beyond the edge of the Caloris Basin. Consists of closely spaced to isolated smooth hummocks and hills, commonly 1 to 2 km across, separated by smooth plains that resemble smooth plains material (unit ps). Locally, hills form concentric patterns with edge of Caloris. Type area: region around lat 25° N., long 170° W. (FDS 191, 72) (McCauley and others, 1981). *Interpretation:* Ejecta from Caloris

com   Odin Formation (Mantling Preexisting Terrain)—Extensive patches of hummocky deposits locally mantle preexisting plains and craters from about 700 to about 1,100 km beyond the Caloris Basin. Consists of closely spaced to isolated rounded hummocks commonly 3 to 8 km across. Mantles lineated and intercrater plains material (unit pl and pi); probably also occurs as deposit too thin to map, mantling intermediate plains material (unit psi). Type area: region around lat 2.5° S., long 170° W. in Tolstoj quadrangle (FDS 56, 63) (McCauley and others, 1982). *Interpretation:* Ejecta from Caloris Basin embayed by smooth plains

cvl   Van Eyck Formation, Lineated Facies—Scattered outward from about limit of weak outer Caloris scarp for distance of about 1000 km. Forms long, wavy radial ridges and intervening grooves. Some ridges sharply bounded by scarps. Extensively embayed by smooth plains material (unit ps). Type area: southwest edge of Van Eyck Basin near 40°, 163° (FDS 189) (McCauley and others, 1980). *Interpretation:* Ejecta from Caloris and radial structures formed by Caloris event. Most grooves are probably buried secondaries. Ejecta from shallower layers in pre-Caloris surface than those that were source of other formations in Caloris Group

CRATER MATERIALS

CRATER MATERIALS—Craters > 30 km in diameter. *Interpretation:* Impact-crater material showing various degrees of degradation and burial

c_5 Crater-rim and -wall material of craters with fresh-appearing sharp rims, wall terraces, and central peaks; usually has associated ray patterns. Sharp break between wall and floor materials. *Interpretation:* Rim composed of overturned flap and fallback; wall is bedrock, includes some slump material

cp_5 Central peaks of very fresh craters. Peaks either single or multiple *Interpretation:* Formed by rebound after impact

cf_5 Crater-floor material of apparently very fresh craters. Surface of material hilly and ridged. *Interpretation:* Highly brecciated material formed by impact; some may be fallback

c_4 Crater-rim and -wall material of crater with prominent, continuous, and only slightly subdued rims and with wall terraces and central peaks. Rays absent, although field of secondary craters is well defined. Break of slope at base of inner wall distinct. Surface texture of rims well preserved. Few superposed craters. Included in this class may be some c_5 craters near terminator, where bright rays are difficult to observe

cp_4 Same as cp_5 except occurs within c_4 craters. Peaks either single or multiple

cf_4 Same as cf_5 except occurs within cp_4 craters. Surface of material is hilly and ridged

cr_4 Radial-ejecta material and secondary craters forming an annulus outside unit cr_4. Shown only for craters >100 km in diameter

cs_4 Secondary-crater material forming crater chains; associated with c_4 craters

c_3 Material of craters with low rounded, but continuous rims, around which the field of secondary craters is still visible but subdued. Secondary-crater field ill defined on craters <50 km in diameter. Moderate number of superposed craters

cp_3 Same as cp_5 except occurs within c_3 craters. Peaks either single or multiple

c_2 Material of craters with greatly subdued, continuous to discontinuous rims; wall terraces absent or highly subdued. Central peaks subdued. No visible secondary fields; many superposed craters

c_1 Material of craters with flat floors and extremely low, commonly discontinuous rims rising only slightly above intercrater plains. Terraces and secondary craters absent

cg Material of ghost craters, cannot be dated by the usual sequence of degradation; mantled by plains units. Age may range from late c_1 to late c_3

Contact—Dashed where approximately located owing to poor resolution.

Lineament

Scarp—Line marks base of slope; Barb points downslope

Ridge—Similar to lunar mare ridges. Caused by buckling of surface and possibly by volcanic extrusion. Symbol on ridge crest

Depression of structural origin, linear to arcuate-Barbs point downslope

Crater rim crest for c_5, c_4, and c_3 craters

Discontinuous segment of crater rim crest

Crater rim crest—Crater material too degraded to map or, if fresh, mantled by younger material

Crestline surrounding Caloris Basin—Interpreted as structural ring fracture formed during and immediately after impact

Areas of bright crater-ray material—Interpreted as ejecta from very recent impacts

INTRODUCTION

The only spacecraft images of Mercury are those taken by the Mariner 10 spacecraft, which made three passes of the planet in 1974–75 (Murray and others, 1974a,b; Strom and others, 1975a; Davies and others, 1978). Most images used in mapping the geology of the Shakespeare quadrangle were taken during the near-equatorial first pass, with close encounter or the dark side of the planet. The second, south-polar pass did not image the Shakespeare quadrangle at high resolution. High-resolution images of small areas within the quadrangle were also obtained during the third pass, when the spacecraft was on a near-encounter north-polar trajectory. Because the spacecraft viewed the same areas from different positions during the first and second passes, stereoscopic pictures are available for certain areas of the southern hemisphere; however, such pictures are not available for the Shakespeare quadrangle. All of the Mariner 10 passes occurred under similar lighting conditions. Across the Shakespeare quadrangle, these conditions varied from low light at the terminator near the west boundary to higher sun at the east boundary. Consequently, lighting conditions were favorable for determining fine-scale relief in the west, but progressively less so toward the east. Conversely, albedo features such as bright crater rays, which are conspicuous in the eastern part, become increasingly difficult to recognize westward toward the terminator. This range of lighting conditions across the quadrangle results in inconsistent geologic mapping, because topography, albedo, and surface texture are critical for characterizing individual materials units. The average resolution of the pictures used from the first pass is just over 1 km.

The map includes a strip of about 10° of longitude (averaging 400 km in width) of the Liguria quadrangle (H-4) to the west-as much of this quadrangle as is permitted by resolution and lighting conditions.

REGIONAL SETTING

The dominant feature in the Shakespeare quadrangle is the Caloris Basin, 1,300 km in diameter. This impact basin is the largest and best preserved on the hemisphere of Mercury observed by Mariner 10. Almost the entire eastern half of the basin is in the Liguria quadrangle part of this map; the west half was in the nightside hemisphere of Mercury during all the Mariner 10 passes, and part of the southern half lies in the adjacent Tolstoj quadrangle (Schaber and McCauley, 1980). Surrounding Caloris is a discontinuous annulus of its ejecta deposits, called the Caloris Group (units cm, cn, co, com, cvl, and cvs). Caloris ejecta are embayed and partly covered by a plains unit (unit ps) that lies mostly in large, roughly circular depressions, some of which may be ancient degraded basins. This plains material also occurs in the floors of old craters and in small irregular topographic lows.

The eastern part of the Shakespeare quadrangle consists mainly of cratered terrain and intercrater plains. Over the whole of the mapped area are scattered fresh craters superposed on other units; in the eastern part the large fresh craters show well-developed bright rays.

STRATIGRAPHY
PRE-CALORIS MATERIALS

The oldest recognizable map unit in the quadrangle is the intercrater plains material (unit pi). These plains were originally described by Trask and Guest (1975) as intercrater plains. The unit has a surface expression of rolling to hummocky plains in the areas between large craters and is exposed mainly in the eastern part of the mapped area. The surface of the unit is pockmarked with craters, many of which are small (about 5 to 10 km in diameter), elliptical, and shallow; they are inferred from their shape to be secondary craters associated with larger craters and basins. Trask and Guest (1975)

concluded that the surface of these plains represents a primordial surface of Mercury on which craters have been superposed. The large extent of this surface compared to its counterpart on the Moon was thought to reflect the restricted distribution of ejecta around each individual crater caused by the relatively high gravity on Mercury (Gault and others, 1975). Because of this high gravity, considerable areas were unaffected by crater and basin ejecta. However, Malin (1976) and Guest and O'Donnell (1977) have shown that in some areas the intercrater plains overlie highly degraded craters, a relation suggesting either that the intercrater plains were formed during a specific time in Mercury's history and that cratering occurred both before and after their emplacement, or, alternatively, that the intercrater plains were formed by a continuous process throughout cratering history.

In several parts of the quadrangle, especially on the margins of large expanses of smooth plains materials, is a unit of smoother and less rolling plains that have a lower crater density. Following Schaber and McCauley (1980), we here call this unit intermediate plains material (unit psi). It is difficult to map with precision because it grades into both the intercrater plains and the smooth plains. Also, its recognition depends on lighting conditions that vary across the mapped areas, especially east of long 120°. The presence of this unit suggests that the plains-forming process spanned much of the early geologic history of Mercury and continued long after the peak of cratering. In the southern part of Sobkou Planitia, intermediate plains have a lower albedo than the adjacent plains. In some places, they may simply represent areas of intercrater plains that have been partly flooded by the younger smooth plains material.

Lineated plains material (unit pl) was recognized by Trask and Guest (1975) as forming terrain consisting of lines of hills and valleys, some of which are as much as 300 km long. This unit modified older large craters and intercrater plains. Its features are similar to those of the lunar Imbrium sculpture (Gilbert 1893) and to the hills and valleys radial to the Nectaris Basin on the Moon (Stuart-Alexander, 1971). The lineations were probably formed in a similar way to those of the Imbrium sculpture, which resulted from excavation by projectiles ejected at low angles from the Imbrium Basin; however, some of the mercurian valleys may be the result of faulting. Most of the lineated material in the Shakespeare quadrangle appears to be subradial to an ancient basin lying between Odin Planitia and Budh Planitia centered at lat 28° N., long 158° W. However, except for its northernmost exposure, the surface of this unit is mantled by a facies (unit com) of the Odin Formation.

Hilly plains material (unit h) consists of low, rounded, closely spaced hills with relatively few superposed craters. The hills range in size from 1 to 2 km across and were estimated to have heights of 100 to 200 m by Trask and Guest (1975), who first recognized this unit and named it hilly terrain. The main tracts of hilly material occur in a roughly concentric band outside the Caloris ejecta. It is possible that this unit is associated with Caloris, although apart from geographical distribution, there is no supporting evidence. In some places, contact relations suggest that the hilly plains material may be older than intermediate plains material (unit psi). Also, patches of the hilly material may be associated with intercrater plains materials in the eastern part of the quadrangle, where lighting conditions do not allow its recognition.

CALORIS GROUP

Rock units associated with the Caloris Basin are particularly important for the stratigraphy of Mercury. It has been demonstrated that the history of the Moon was punctuated by a series of major impacts that have emplaced ejecta over widespread areas; the rock units associated with these impact basins were used to divide the lunar stratigraphic column into a series of well-defined time units (Shoemaker and Hackman, 1962; McCauley, 1967; Wilhelms, 1972). These relations are particularly clear for the

Imbrium Basin (Wilhelms and McCauley, 1971) and Orientale Basin (Scott and others, 1977).

Recognizable ejecta units extend outward from the Caloris Basin as far as one basin diameter; these units can be used to divide the mercurian stratigraphic column in much the same way as basin ejecta were used on the Moon. A stratigraphic and structural comparison between the Caloris and Orientale Basins has been made by McCauley (1977).

On the basis of geologic mapping of the Shakespeare and Tolstoj quadrangles, the authors of these two maps and other workers (McCauley and others, 1981) have constructed a formal rock stratigraphy that is used on this map and have proposed the name "Caloris Group" to include the mappable units created by the impact that formed the Caloris Basin. These units are here described in order, from the basin rim outward.

1) The Caloris Montes Formation (unit cm) was first recognized by Trask and Guest (1475) and informally called the Caloris mountain terrain. The unit consists of segmented, smooth-surfaced massifs rising several kilometers above the surrounding terrain to form the prominent mountain ring surrounding the Caloris Basin. This mountain material may be interpreted as uplifted bedrock on the rim of the Caloris Basin produced in the last stages of elevation by the impact of an asteroid-size body. The unit may be analogous to the massif facies of the Montes Rook Formation around the Orientale Basin (Scott and others, 1977; McCauley and others, 1981). The mountains are probably veneered with fallback materials. A gap is present in the Caloris Montes toward the southeast; its origin is unknown, but it is somewhat similar to the gap on the east side of the Imbrium Basin, where the mountain ring cuts the edge of the Serenitatis Basin. On Mercury, however, we have no evidence for the presence of a preexisting basin east of Caloris.

2) The Nervo Formation (unit cn) is a plains unit that occurs in depressions between the mountains formed by the Caloris Montes Formation. The unit occurs at different elevations in the mountain chain and appears to drape the lower massifs. It is analogous to the Montes Appeninus material (Wilhelms and McCauley, 1971) around Imbrium and the knobby facies of the Montes Rook Formation in Orientale (Scott and others, 1977). Trask and Gilbert (1975), who first recognized this unit as intermontane plains material, interpreted as fallback ejecta to explain its distribution, relative roughness, and generally perched position above the smooth plains material (unit ps) that surrounds Caloris.

(3) The Odin Formation (units co and com) was mapped by Trask and Guest (1975) as hummocky plains and described as low, closely spaced to scattered hills about 0.3 to 1 km across and from tens of meters to a few hundred meters high. In some places the hills are alined concentrically with the rim to the Caloris Basin, and the plains appear corrugated. The area between hills is occupied by material identical in surface characteristics to that of the smooth plains unit (unit ps); in some areas the Odin Formation may be partly flooded by smooth plains materials. Because the relief on the Odin Formation is low, identification depends much on image resolution and lighting, and some outcrops may not have been recognized. The Odin Formation is analogous to the Alpes Formation (Wilhelms and McCauley, 1971) of the Imbrium basin. As unit com, the Odin locally mantles intercrater plains, lineated plains, and intermediate plains materials to a distance of 1,100 km from the Caloris Basin scarp. Unit com is similar to the thinner. more distal parts of the Alpes Formation on the Moon. The lower lying parts of unit com were later partly buried and embayed by the younger smooth plains material (unit ps).

4) The Van Eyck Formation has a lineated facies (unit cvl) and a secondary-crater facies (unit cvs). The lineated facies extends from the Caloris Montes as much as about 1,000 km. It consists of long, hilly ridges and grooves that are subradial to the Caloris Basin. The unit is generally similar in appearance to the outer part of the Fra Mauro Formation of the Imbrium Basin on the Moon. The lineated facies was mapped by Trask and Guest (1975) as Caloris lineated terrain. Over much of its outcrop, it appears to be

veneered by a thin plains unit that has filled hollows in the surface. The plains unit in these areas has generally been infilled with the Van Eyck Formation, although it may, in part, be smooth plains material (unit ps). The lineated facies is interpreted as ejecta associated with secondary cratering from the Caloris Basin. It is noteworthy that this lineated terrain occurs near the foot of the Caloris Montes, whereas similar units of the Imbrium Basin on the Moon occur farther from the basin rim. Such a difference in extent is to be expected because mercurian gravity is two and a half times greater than lunar gravity, and ejecta would fall closer to its source than ejecta from a similar-size basin on the Moon (Gault and others, 1975).

In the Shakespeare quadrangle, only a lineated facies of the Van Eyck Formation is recognized, whereas in the Tolstoj quadrangle to the south, both it and a secondary crater facies are mapped (Schaber and McCauley, 1980; McCauley and others, 1981).

POST-CALORIS MATERIALS

The plains material (unit cfp) that forms the floor of the Caloris Basin has not been included in the Caloris Group and is mapped separately from the smooth plains. In many way, the Caloris-floor plains are similar to the smooth plains, except that they have been buckled and fractured into numerous ridges and grooves that intersect to form a grossly polygonal pattern. The dominant trends of these features are concentric and radial to the center of Caloris. On the basis of photometric evidence, Hapke and others (1975) suggested that the central part of the basin floor may be 7±3 km lower than the outer edge. Strom and others (1975b) argued that the ridges were formed by compressive stress generated by subsidence of the floor, and the fractures by subsequent uplift of the center of the basin to produce crustal lengthening and the observed fracture pattern. The origin of the material itself is doubtful. It may consist of sheets of volcanic material emplaced shortly after the basin was formed or it may be material formed by the Caloris event either as melt or as the upper part of a plug of plastic material that rose in the crater floor as part of the impact process. Whatever the origin of this material, it seems clear that it covers the original floor of the excavated crater.

The smooth plains material (unit ps) forms essentially level tracts, flooring depressions in the mercurian surface. The most extensive of such areas in this quadrangle are Sobkou and Budh Planitiae. The surface of the smooth plains material is relatively sparsely cratered, and overlap relations indicate that these plains units are younger than the intercrater plains and intermediate plains. Smooth plains also embay units of the Caloris Group Smaller patches of smooth plains occur in depressions and old crater floors. In many areas, especially those closer to the Caloris Basin, they exhibit mare ridges like those on the Moon and thus have a rolling appearance. The boundary between smooth plains and the Odin Formation is not everywhere clear, except at high resolution. Smooth plains are mapped in the Shakespeare quadrangle only where there is no clear evidence of small hills characteristic of the Odin Formation.

Interpretation of the origin of the smooth plains is difficult but significant, because it bears directly on the internal constitution and thermal history of Mercury. Like the lunar maria, the smooth plains occur on the floors of large craters and basins, and the broad swath of plains around Caloris finds an analogy with Oceanus Procellarum around Imbrium on the Moon. However, the Caloris plains, at the map scale, differ from the maria in having no observed positive-relief volcanic features such as those sparsely scattered on the lunar maria. The absence of sharp albedo differences between the smooth plains and the older terrain (Hapke and others, 1975), compared with the distinct difference in albedo between the lunar maria and highlands, may be more indicative of composition than of origin of the rocks. On the basis of distribution and volume, Strom and others (1975b) argued that in most areas the smooth plains consist of extensive sheets of basic lava similar to the lunar maria. Schultz (1977), studying

modified impact craters, also argued in favor of volcanism. On the other hand, Wilhelms (1976) pointed out that the lunar light plains could also serve as an analog of the mercurian smooth plains: Apollo 16 samples indicate that lunar light plains consist of cataclastic breccia and impact melt, interpreted as being emplaced by large impact events (James, 1977). Wilhelms (1976), therefore, proposed that the smooth plains on Mercury may be related to the Caloris impact directly, as breccias and impact melts, rather than as lavas. However, the light plains on the Moon are nowhere so well developed or extensive as the plains around Caloris, and if Wilhelms' explanation is correct, considerable differences must exist between large impact events on the Moon and Mercury. Most likely, large parts of the smooth plains are of volcanic origin, although in some areas they may be of impact-melt origin.

The very smooth plains on Mercury were included in the smooth plains unit by Trask and Guest (1975). Here the geologic units are mapped separately, because very smooth plains material (unit pvs) is clearly younger than smooth plains material (unit ps): the very smooth plains unit occurs in c_4 -age craters, which are in turn superposed on smooth plains. The very smooth plains unit, which is featureless and has no resolvable superposed craters, is possibly ejecta fallback on the floors of the c_4 craters. However not all craters contain this material; some are floored by material with a rugged surface mapped here as crater floor material (unit cf_4 and cf_5), because it is analogous to the floor material in younger lunar craters such as Copernicus or Aristarchus. One other possibility is that the very smooth plains are volcanic.

CRATER MATERIALS

The craters on Mercury show various states of preservation, ranging from crisp-featured craters with bright rays to those that are almost totally obliterated and consist only of a subdued ring of heavily cratered hills. As on the Moon, the principal eroding process is likely impact; thus, a fresh crater will be degraded systematically over time. Craters of similar size that show similar states of preservation are therefore considered to be of about the same age. Craters are mapped according to a fivefold classification on the basis of their states of degradation (McCauley and others, 1981). The components used to define the crater ages are rays, secondary craters, ejecta facies, central peaks and rings, rim form, and inner terraces. As a crater ages, the number of superposed craters increases and each of the morphologic elements becomes more subdued. Volcanic activity also may bury or destroy certain crater components, but the crater may still be dated by the preservation of the remaining rim. On the basis of mapping in this quadrangle and in the adjacent Tolstoj quadrangle (Schaber and McCauley, 1980), the Caloris impact is considered to have occurred in late c_3 time (McCauley and others, 1981).

One problem with the above-mentioned crater-dating technique on Mercury is that secondary craters occur closer to the principal crater and are thus more clustered than on the Moon, where they are relatively widespread. In consequence, an older crater adjacent to a fresh one becomes strongly degraded as a result of heavy bombardment by secondary craters from the younger crater and appears much older than it is.

Ghost craters (unit cg) are unusual forms that occur in the Suisei Planitia. They are buried and rounded in profile, with only their rim crests rising above the surrounding smooth plains unit (ps). Therefore, these craters cannot be assigned a specific age; they may be of any age from late c_1 to late c_3.

STRUCTURE

The most conspicuous structural elements in the quadrangle are the radial and concentric ridges and cracks inside the Caloris Basin and the ridges developed in the Odin Formation and smooth plains unit immediately outside Caloris (Strom, 1979). O'Donnell and Thomas (personal communication, 1979) have suggested, on the basis of

orientation of features outside Caloris, that these ridges and scarps largely follow preexisting radial and concentric fracture patterns in the mercurian lithosphere initiated by the Caloris impact, similar in character to those around Imbrium on the Moon (Mason and others, 1976). Caloris itself consists of a single mountain ring and a weak outer scarp. A few sinuous scarps also occur in this quadrangle, including the Heemskerck Rupes which cuts the older intercrater plains. Scarps of this type are considered by Strom and others (1975b) to be compressive thrust faults resulting from overall shortening of the mercurian crust early in its history.

GEOLOGIC HISTORY

The history of the Shakespeare quadrangle as evidenced by materials exposed at the surface begins with the formation of intercrater plains material (unit pi) and of impact craters both older and younger than these plains. Some c_1 and c_2 craters were superposed on the intercrater plains. The intermediate plains material (unit psi) and lineated plains unit (pl) were emplaced over the intercrater plains, as were most craters of c_3 age. Then followed the major asteroidal impact that produced the Caloris Basin and the emplacement of rocks of the Caloris Group around the basin. Comparison of crater populations on surfaces older and younger than Caloris suggests that at the time of the Caloris impact, the population of craters smaller than 30 km in diameter was eradicated from the pre-Caloris terrain (Guest and Gault, 1976). Gault and others (1976) suggested that the smaller craters were destroyed by the Caloris event and by other basin-forming events elsewhere on the planet at about the same time.

The smooth plains material (unit ps) was then emplaced. Some c_3 craters were formed after the Caloris event and after some of the smooth plains were formed. Superposed on the smooth plains unit and on all older deposits were craters of c_4 age, inside which was emplaced the very smooth plains material (unit pvs). Analogy with the Moon suggests that most of the recorded events in the history of Mercury occurred during the first 1.5 b.y. of the planet's life; the oldest major rock units in this quadrangle are probably at least 2 to 3 b.y. old. The geologic history of Mercury has been summarized by Guest and O'Donnell (1977), Davies and others (1978), and Strom (1979).

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NOTES ON BASE

This map sheet is one of a series covering that part of the surface of Mercury that was illuminated during the Mariner 10 encounters (Davies and Batson, 1975). The source of map data was the Mariner 10 television experiment (Murray, 1975).

ADOPTED FIGURE

The map projections are based on a sphere with a radius of 2439 km.

PROJECTION

The Lambert conformal conic projection is used for this sheet, with a scale of 1:4,623,000 at lat 22.5° N. Latitudes are based on the assumption that the spin axis of Mercury is perpendicular to the plane of the orbit. Longitudes are positive westward in accordance with the usage of International Astronomical Union (IAU, 1971). Meridians are numbered so that a reference crater named Hun Kal (lat 0.6° S.) is centered on long 20° W. (Murray and others, 1974; Davies and Batson, 1975).

CONTROL

Planimetric control is provided by photogrammetric triangulation using Mariner 10 pictures (Davies and Batson, 1975). Discrepancies between images in the base mosaic and computed control-point positions appear to be less than 2 km. Since the base mosaic was controlled by a later iteration of the control net, discrepancies as large as 20 km are present between the Tolstoj (H-8) and Beethoven (H-7) sheets to the south. These were adjusted during compilation for consistency between the sheets. Similar discrepancies were adjusted along the east edge, joining the Victoria (H-2) quadrangle. In addition to differences between the control nets, pictures along this edge were so foreshortened that precise feature placement was impossible.

MAPPING TECHNIQUES

Mapping techniques are similar to those described by Batson (1973a,b). A mosaic was made with pictures that had been digitally transformed to the Lambert conformal conic projection. Shaded relief was copied from the mosaics and portrayed with uniform illumination with the sun to the west. Many Mariner 10 pictures besides those in the base mosaic were examined to improve the portrayal. The shading is not generalized and may be interpreted with nearly photographic reliability (Inge, 1972; Inge and Bridges, 1976).

Shaded relief analysis and representation were made by P. M. Bridges.

NOMENCLATURE

All names on this sheet are approved by the International Astronomical Union (IAU, 1977).

H-3:   Abbreviation for Mercury (Hermes) sheet number 3.
H 5M 45/135 G: Abbreviation for Mercury (Hermes) 1:5,000,000 series; center of sheet 45° N. lat, 135° long; geologic map, G.

A small part of the H-4 quadrangle is included on this sheet, because insufficient data are available to justify preparation of a separate sheet.

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