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Preliminary Geologic Map of the Lathrop Wells Volcanic Center

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PRELIMINARY GEOLOGIC MAP OF THE LATHROP WELLS VOLCANIC CENTER

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INTRODUCTION

A preliminary geologic map (see page 7) has been compiled for the bedrock geology of the Lathrop Wells volcanic center. The map was completed through use of a combination of stereo photographic interpretation and field mapping on color aerial photographs. These photographs (scale 1:4000) were obtained from American Aerial Surveys, Inc. They were flown on August 18, 1987, at the request of the Yucca Mountain Project (then Nevada Nuclear Waste Storage Investigations). The photographs are the Lathrop Wells VC-Area 25 series, numbers 1-32. The original negatives for these photographs are on file with American Aerial Surveys, Inc. Copies of the negatives have been archived at the Los Alamos National Laboratory, Group N-5.

The geologic map for this report was compiled on uncorrected color aerial photographs at a scale of 1:7370 from the mapping on the 1:4000 scale photos. These photographs were flown by EG&G on September 10, 1987. The photographs are the EG&G 5826 series, numbers 016-033.

The compiled geologic mapping is regarded as preliminary for several reasons. First, the mapping was not transferred to a controlled topographic base map. Some scale distortion may occur for parts of the map where the geology was compiled at the edges of individual photographs. Second, additional information will be obtained from continuing geochronology, geomorphic, soils, and paleomagnetic studies at the center. Ongoing studies could result in modifications of the stratigraphic sequence of the units, but the basic geologic contacts drawn on the preliminary map should remain unchanged. Third, we were unable to obtain permission to undertake detailed field studies in the area labeled as Quarry Site on the preliminary map. Some of the volcanic deposits in that area have been removed by quarrying activity and others have been modified significantly. Geologic mapping in that area will require construction of local trenches to decipher the field relations of the interbedded geologic units.

The preliminary geologic map is a bedrock geologic map. It does not show alluvial deposits, eolian sands, or scoria fall deposits from the youngest eruptive events. The units will be compiled on separate maps when the geomorphic and soils studies are more advanced.

ERUPTIVE EVENTS AT THE LATHROP WELLS VOLCANIC CENTER

The reconstructed eruptive events at the Lathrop Wells volcanic centers, based on the results of field studies, are (from oldest to youngest):

1. Development of a northwest-trending fissure zone in the central part the map area (Qs_5). This fissure is marked by local vents consisting of irregular scoria mounds and agglutinate. Small-volume blocky aa flows were erupted from several localities on the southwest and southeast ends of the fissure zone (Ql_5). An isolated outcrop of partially buried lava flows (Ql_5?) north of the main scoria cone is inferred to have vented from the northwest-trending fissure zone.

2. Formation of numerous (3 to possibly 10) small scoria cones at the south end of the main scoria cone of the volcanic center. These cones have been almost completely destroyed by commercial quarrying of the scoria deposits in the quarry area. This geologic unit is not shown on the geologic map.

3. Formation of the major scoria cone mass of the main scoria cone (Qs_1). This unit was accompanied, primarily in the early stages, by hydrovolcanic eruptions that formed pyroclastic surge deposits on the northwest and southeast flanks of the scoria cone.

COMMENT: The geologic relations of the three oldest eruptive events are based in part on the results of studies of the paleomagnetic pole positions of the units. These data show that the northwest-trending fissure zone, the small scoria cones, and the in-place bombs from the interior of the summit of the main scoria cone all yield the same paleomagnetic pole position. These data are incomplete and are still being evaluated. We currently interpret the results to indicate that the first three volcanic events occurred during a short time period and that these events represent the oldest activity at the volcanic center. These interpretations may change as further paleomagnetic and geochronology studies are completed.

4. Development of a small east-west trending fissure in the north central part of the map area (Qs_4). This fissure is marked along its length by a number of small scoria mounds. Very-small-volume blocky aa flows were erupted from multiple sites along the fissure (Ql_4).

COMMENT: The stratigraphic position of this unit is based on the presence of pyroclastic surge deposits within alluvial deposits that are inferred to occur between units Qs_4, Ql_4, and Ql_5? (see map relations north of the main scoria cone). This interpretation will be tested by constructing trenches and studying the alluvial volcanic units beneath the Qs_4 and Ql_4 units.

5. Development of a second, northwest-trending fissure zone in the northeast part of the map area (Qs_3). This fissure zone is marked by one major scoria mound at its northwest end and a partly buried scoria mound at its southeast end. The fissure probably extended farther to the southeast but is buried by its own lava flows. The major area of blocky aa lava flows (Ql_3) in the northeast and east part of the map area vented from numerous localities (some exposed, some buried) along the length of the fissure.

6. Eruption of very-small-volume (approximately 10^5 m^3) scoria fall deposits from the summit crater of the main scoria cone. There were at least two, possibly more, eruptions of this type. Deposits from these eruptions drape the main scoria cone and form thin surface coverings northwest and southeast of the main scoria cone.

STATUS OF ONGOING STUDIES

Field and geochronology studies will establish the detailed volcanic history of the Lathrop Wells center. These studies include:

1. Potassium-argon (K-Ar) age determinations of lava flow units (B. Turrin, U.S. Geological Survey, and the Berkeley Geochronology Center).

2. Uranium-thorium disequilibrium measurements using solid source mass spectrometry of volcanic units (M. Murrell, Los Alamos National Laboratory).

3. Surface exposure ages of the volcanic units using $^3He/^4He$ ratios (J. Poths, Los Alamos National Laboratory and B. Turrin, U.S. Geological Survey, and the Berkeley Geochronology Center).

4. Geomorphic parameter studies of volcanic landforms (S. Wells and C. Renault, University of New Mexico).

5. Analysis of soil development on volcanic landforms (L. MacFadden, University of New Mexico).

6. Petrological and geochemical studies of lava and scoria units (F. Perry, University of New Mexico).

7. Cation ratios of rock varnish on volcanic units (C. Harrington, Los Alamos National Laboratory).

Major conclusions based on preliminary results from these studies include:

1. The Lathrop Wells volcanic center is much younger than the 270 000 years bp (before present) age referenced in the Environmental Assessment Report (DOE 1986).

2. The results of revised K-Ar age determinations of the lava flows of the center indicate that they cannot be dated reliably using the K-Ar technique for whole-rock samples. This is inferred to result from a combination of the young age of the lavas and the presence of excess argon in the samples. Our current estimate of the age of the oldest lavas of the center, which is based on the range of ages obtained from K-Ar determinations, erosional modification of the lava flow surfaces, and development of soils

on the lavas, is less than 100 000 and probably less than 50 000 years bp.

3. Field mapping and paleomagnetic pole position data indicate that there were multiple eruption events at the volcanic center. We originally inferred, based on the results of K-Ar age determinations of the lavas, that the time between eruptions exceeded 100 000 years. We now feel the eruptions may have been separated by only a few tens of thousand years.

4. The age of the youngest volcanic event (small-volume eruptions that mantled the scoria cone surface) at the Lathrop Wells center has not been firmly established. Analyses of the geomorphic degradation of the scoria cone, the degree of development of soils on the cone surfaces, and the surface position of tephra fall units in recent alluvial deposits suggest the youngest eruptions could be as young as mid-Holocene (Wells et al. 1988). Uncertainties in the calibration of these parameters are permissive, with an inferred age as old as 10 000 to 15 000 years bp.

GEOLOGIC UNITS OF THE LATHROP WELLS VOLCANIC CENTER

Qa_1: Quaternary alluvial deposits undivided. Mapped only in the central part of the geologic map where the deposits separate major map units.

Qs_1: Scoria deposits of the major scoria cone of the Lathrop Wells center. The youngest eruptive deposits are not differentiated on the map.

Qps_1: Thin-bedded, locally crossbedded, slightly palagonitized pyroclastic surge deposits. Inferred to have been deposited during the early stages of evolution of the main scoria cone. These deposits are also inferred to occur between, stratigraphically, the Ql_4 and Ql_5 lavas. Thin pyroclastic deposits on the southeast side of the main cone are not shown on the map.

Qs_3: Scoria deposits, vent agglutinate, and local dikes associated with the younger northwest-trending fissure zone.

Ql_3: Lobate, blocky aa lava flows that vented from the younger northwest-trending fissure zone. These deposits are partly covered by eolian deposits over much of their outcrop area.

Qs_4: Scoria deposits, vent agglutinate, and local dikes associated with the east-west trending fissure zone. Vent zones are marked by irregularly shaped scoria mounds. These deposits are partly to completely covered by scoria fall deposits from the youngest eruptions of the main cone and by eolian deposits.

Ql_4: Lobate, blocky aa lava flows that vented from the east-west-trending fissure zone.

Qs_5: Vent agglutinate, scoria deposits, and local dikes associated with the older northwest-trending fissure zone. The fissure zone is marked by irregularly shaped scoria and agglutinate mounds. These deposits are mantled by scoria fall deposits near the main scoria cone.

Ql_5: Lobate blocky aa lava flows that vented from the older northwest-trending fissure zone. Major vent areas for the lava flows are in the southwest and southeast ends of the fissure zone. Separate flow lobes that are inferred to be associated with this unit are present north and southwest of the main scoria cone.

EXPLANATION OF GEOLOGIC SYMBOLS

1. Geologic Contacts: solid lines, dashed where approximately located, dotted where inferred.

2. Circles with inward facing bars: topographic margins of scoria mounds that are inferred to mark vent zones. The scoria mounds do not have observable crater rims. Dashed where boundaries are approximately located.

3. Circle with inward facing filled triangles: crater rim of the main scoria cone.

4. Cross-hatched line: boundary of the main scoria cone.

5. Solid heavy lines with arrows: lava channel with arrow indicating lava flow direction.

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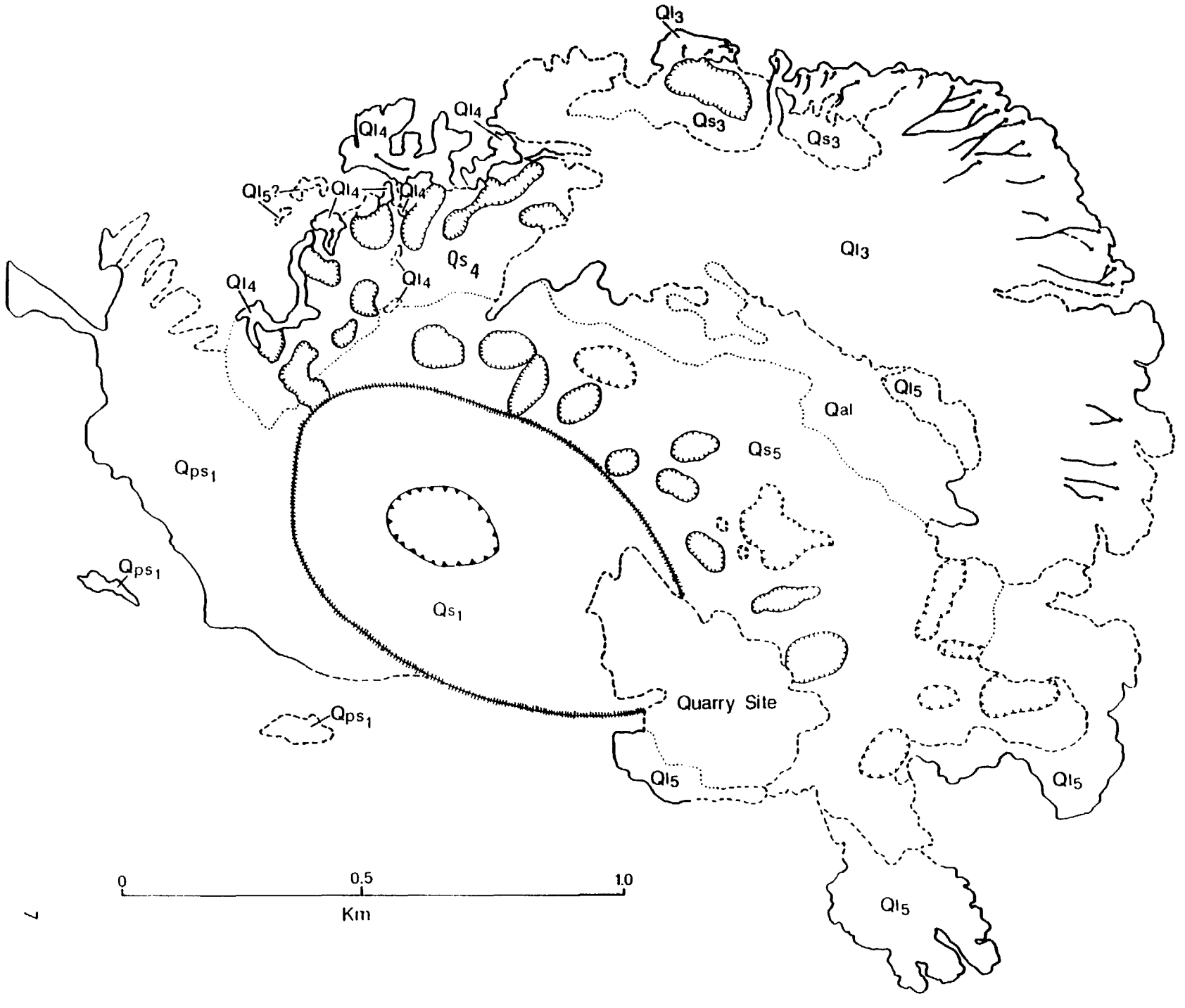
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