Table of Contents

Previous Work. .......................................................... 5
Acknowledgments. .................................................... 6
General Stratigraphy in the Northern Plomosa Mountains . . 8
   Precambrian. ....................................................... 8
   Paleozoic. .......................................................... 10
   Mesozoic . .......................................................... 13
   Cenozoic . .......................................................... 14
Geologic Relations in the Northern Plomosa Mountains . . . 17
   Structures . ......................................................... 17
   General Descriptions of Lithologies Within Plates. . . . 17
      1) Bighorn Plate . ............................................. 17
      2) Plomosa Pass Plate. ......................................... 17
      3) Tough Nut Plate ............................................ 21
      4a) and 4b) Deadman Plate. .................................. 21
      5) Plomosa Plate . .............................................. 21
Dikes. ......................................................................... 22
Structural Observations and Interpretations. .................... 24
   1. Plomosa Fault .................................................. 24
   2. Order of Structural Stacking. ............................... 24
   3. Vergence Indicators .......................................... 24
   4. Movement on Plomosa Fault .................................. 25
Economic Geology ...................................................... 27
   Base and Precious Metals ....................................... 27
<table>
<thead>
<tr>
<th>Ferrous Metals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
</tr>
<tr>
<td>Manganese</td>
</tr>
<tr>
<td>Industrial minerals</td>
</tr>
<tr>
<td>Barite</td>
</tr>
<tr>
<td>Bentonite</td>
</tr>
<tr>
<td>Uranium Potential</td>
</tr>
<tr>
<td>Petroleum Potential</td>
</tr>
</tbody>
</table>

List of Figures

A. Chronology of rock units and major events.

1. Reconnaissance geologic map of the northern Plomosa Mountains, La Paz County, Arizona.

2. Geologic map - Plomosa Pass area.

3. General sketch tectonic map of northern Plomosa Mountains.

4. Geologic cross-section of the Plomosa Mountains.
1983 AGS Fall Field Trip Route

Led by
Bob Scarborough, Steven Reynolds, and Jon Spencer
Arizona Bureau of Geology and Mineral Technology
Organized by
Stanley B. Keith and Jan C. Wilt
MAGMACHEM Associates

DAY 1 - November 5, 1983
Northern Plomosa Mountains
1. Northern Plomosa Mountains overview
2. Plomosa Pass Thrust
3. Plomosa detachment fault and upper plates rotated thrusts

DAY 2 - November 6, 1983
Granite Wash Mountains and Salome Region
4. Granite Wash Mountains overview
5. Thrust faults in Granite Wash Mountains
6. Hercules Thrust (Alternate stop)
7. Golden Eagle Thrust and Socorro Mine
Previous Work

The northern Plomosa Mountains were actively explored and mined for base and precious metals following the construction of the Arizona and California railroad that passed through Bouse in the very early 1900's. The Little Butte, Malakitt, Hearts Desire, and Old Maid mines at the extreme northern end of the range were producing mines when the U. S. Geological Survey published Willis Lee's "geologic sketch map" (Lee, 1908) of northwestern Arizona. His map only topographically differentiated the Plomosa (his Palomas) mountains from the surrounding desert plains, using only information supplied by railroad engineers.

The first detailed study of the mineral deposits of the northern Plomosa Mountains was by Bancroft (1911). He recognized complex geologic relations between volcanics and limestones in the central Plomosas and recognized that the mineralized host rocks of the Mudersbach copper camp had been affected by the intrusion of a nearby pluton, which is termed the Mudersbach pluton in this report. In the area of this mine he recognized gypsiferous strata that he thought "resulted from the alteration of limestone in place, the alteration being carried on by the sulphuric acid liberated in the oxidation of pyrite, which is found in all stages of decomposition in the deposit." An alternative explanation is offered in this report.

Little more geologic information was known when Clyde Ross made a few observations in the northern Plomosas (Ross, 1922). He noted the presence of limestones at the extreme north end of the Range that he likened in their low metamorphic grade to those of Paleozoic age around Globe, but the lack of fossils in the Plomosa rocks "renders positive correlation impossible." He also noted that they bore undetermined relationship with the underlying crystalline rocks in the area. In this report, the limestones of which he speaks, near the Little Butte mine, are mapped as Miocene age, while some remnants of Paleozoic limestones are found not far south.

A compilation of reconnaissance mapping of the northern Plomosas by Eldred Wilson was published in 1960 by the
Arizona Bureau of Mines and unchanged in 1969 by the U.S.G.S. as the Arizona State Geologic map (scale 1:500,000). In these maps, Wilson showed the east-west bipart geology of the northern Plomosas for the first time.

In 1966, a map and report on the geology and mineral deposits of the northernmost part of the mountains was prepared by Joe Jemmett (Jemmett, 1966). He recognized the faulted character of the contact between the main mountain block and the terrain to the east capped by Tertiary strata. He considered the carbonates that were interleaved with gneiss as Precambrian in age, and recognized what he thought was a landslide mass of schist overriding Tertiary strata in his northerly terrain at Round Mountain. He also recognized repetition of Tertiary strata along northwest striking "thrust" faults, some of which in this report are interpreted as low-angle normal faults (listric faults). Jemmett gave the most up-to-date description of the mines and geology in the northernmost Plomosas that has been written to date.

Acknowledgments

This report is a direct result of a detailed reconnaissance mapping project in the northern Plomosa Mountains funded by Inca Oil and Gas, Inc. of Ft. Worth, Texas. The goal of the study was to evaluate the overthrust belt nature and petroleum potential of the region, following the regional tectonic synthesis paper by Harald Drewes (Drewes, 1978). Mapping was carried on between September and November, 1981 by Robert Scarborough and Norman Meader, with geological and logistical support by Jan C. Wilt and Stanley B. Keith. Thanks go to Alan T. Washburn and Inca Oil and Gas for permission to publish this report.
RECONNAISSANCE GEOLOGIC MAP
OF THE NORTHERN PLOMOSA MTNS.,
LA PAZ COUNTY, ARIZONA

by
Robert Scarborough and Norman Meader
with assistance by
Jan C. Wilt and Stanley B. Keith

KGS-20 Oct. 1983
field work conducted Sept.-Nov. 1981.

BF Miocene-Pliocene basin fill sediments
Tv Oligocene-Miocene volcanics
Tvs mixed volcanics & sediments (incl. limestones)
TKg Tertiary-Cretaceous biotite granite
Ms Mesozoic sediments (now argillites, etc.)
Ps Paleozoic Sediments (carbonates & quartzites)
PM Paleozoic-Mesozoic volcanics
Precambrian crystalline rocks

Symbols:
--- compositionally layered gneisses
\pem\ medium-grained granite
\pemg\ Kspar porphyritic granite
\ped\ diorite-amphibolite

areas of carbonate-gneiss "card deck" interleaving

thrust fault detachment fault

attitude of compositional layering, with plunge of mineral lineation which extremely developed

dikes - micro-quartz, monomineral to rhodacite, some aplite
GENERAL STRATIGRAPHY IN THE NORTHERN PLOMOSA MOUNTAINS

Rocks representing Precambrian, Paleozoic, Mesozoic, and Cenozoic eras crop out in the northern Plomosa Mountains and are described here. A schematic section of regional stratigraphy is shown in Figure A.

PRECAMBRIAN

Crystalline rocks of probable Precambrian age dominate the main mountain mass in the northern part of the study area. The predominant lithology in the Precambrian terrain is a medium-grained, gray-colored, foliated, quartzo-feldspathic, gneissic unit. From brief reconnaissance, the foliation is often weak or absent, and when present appears to change attitude in complex ways, probably by both folding and faulting. Other rock types include compositionally layered (banded) quartzo-feldspathic gneisses, a medium-grained biotite and chlorite granite or quartz monzonite that is probably part of a regional 1,700 m.y.o. suite, small amounts of a potash-feldspar granite porphyry (here called a megacrystic granite) that is probably related to a regional 1,400 m.y.o. suite, and various pegmatites, diabase dikes, and aplites. Minor diorite masses may be a dark phase of the 1.7 b.y.o. granite suite.

Three areas display a foliation that can be related to tectonic events of the region. It is assumed that these foliations, of Phanerozoic age, are imposed locally upon Precambrian foliation(s) that are noted elsewhere in the Precambrian terrain on the map. These three areas are (a) extreme westernmost outcrops of the gneiss in sections 15 and 16, T.6N., R.18W., (b) outcrops of the gneiss structurally just beneath the Plomosa fault, extending for about 8 miles in a north-south direction, and (c) outcrops in section 35, T.6N., R.18W., relatable to Phanerozoic faulting near there.

In certain areas such as the NW 1/4, section 26, T.6N., R.18W., the gneiss displays compositional layering with individual laminar bands in places having thicknesses of millimeters and lateral extents of meters. It is possible that these well-layered gneisses have clastic sedimentary protoliths. In other areas, such as NW 1/4, section 30, T.7N., R.18W., a peculiar banded unit crops out and consists of alternating white and apple-green colored, aphanitic, dense, layered material. The individual bands are from one to five feet thick. The protolith of this material may be
COLORADO RIVER GRAVELS
AND RECENT ALLUVIUM
PLIOCENE BOUSE FM,
LATE TERTIARY BASIN-FILL,
BASALT AND EVAPORITES
BLOCK FAULTING
ANGULAR UNCONFORMITY
TILTING AND LISTRIC NORMAL
FAULTING
MID-TERTIARY VOLCANIC,
SEDIMENTARY AND
INTRUSIVE ROCKS
BASAL ARKOSIC CONG.
UNCONFORMITY
MYLONITIZATION
METAMORPHISM
LATE CRETACEOUS-EARLY
TERTIARY PLUTONS
DEFORMATION-METAMORPHISM
LATE MESOZOIC CLASTIC
ROCKS
MID-MESOZOIC VOLCANIC
AND GRANITIC ROCKS
UNCONFORMITY
PERMIAN KAIBAB LS.
PERMIAN COCONINO SS.
PENNSYLVANIAN-PERMIAN
SUPAI FM.
MISSISSIPPIAN REDWALL LS.
DEVONIAN MARTIN FM.
DISCONFORMITY
CAMBRIAN ABRIGO FM.
CAMBRIAN BOLSA QTZ.
UNCONFORMITY
PRECAMBRIAN METAMORPHIC
AND GRANITIC ROCKS

Fig. 1. Chronology of rock units and major events
(from Reynolds, 1980).
volcanogenic sediments, possibly subaqueous tuffaceous mudstones.

PALEOZOIC

Paleozoic strata in the northern Plomosa Mountains consist of formations that are lithologically correlatable to those of Paleozoic age in adjacent mountain ranges (Reynolds and others, 1980; Miller, 1970; Richard, 1983; Hamilton, 1963). However, virtually without exception, these formations in the northern Plomosas are bounded by tectonic contacts, making all thicknesses minimal. A few fossil gastropods and crinoid columns, not yet identified as to species, were found in limestones at points identified on the map. The most intact Paleozoic section in the northern Plomosas was seen at Round Mountain (SE 1/4, Section 19, T.7N., R.17W.), where the sequence Bolsa Quartzite through at least Supai Formation, or possibly Kaibab Limestone is present in a southwest-dipping section. Even so, the section is attenuated by numerous bedding plane faults and other internal deformations.

Paleozoic strata in the nearby region consist of the typical cratonic shelf assemblage of southeastern Arizona in the lower part of the section and of the Grand Canyon in the upper part of the section (Miller, 1970). Formations include the Cambrian Bolsa Quartzite and the Abrigo Formation (correlative with the Tapeats Sandstone and Bright Angel Shale of the Grand Canyon, respectively), the Devonian Martin Formation, the Mississippian Escabrosa Formation or Redwall Limestone, the Pennsylvanian-Permian Supai Formation, and the Permian Coconino Sandstone and Kaibab Limestone. A section of massive gypsum mixed with green shaly beds may possibly correlate with the alpha or Harrisburg member of the Kaibab Limestone found in northwestern Arizona or it may be of Mesozoic age, as discussed below.

The Bolsa Quartzite and the Abrigo Formation are both very thin in the area and each consist of 15-20 m. or less. The Bolsa Quartzite consists of a hard, medium-grained quartzite with light pink or maroon colors; it weathers to massive cliffs that are stained very dark by desert varnish. The Abrigo Formation consists of thin interbeds of phyllite, fine-grained quartzite, and thin gray- to tan-colored carbonate beds.

The Martin Formation, which disconformably overlies the Abrigo regionally, is a mixture of medium gray and brown sandy dolomite, dolomite, and dolomitic limestone beds and reaches a thickness of 70 to 100 m. Outcrops of the Martin Formation weather to a yellow-brown color.
The Escabrosa Limestone overlies the Martin Formation disconformably and consists of a massive bedded, cliff-forming, sandy dolomite and cherty limestone that can be 125 m thick in an undisturbed section. Fresh colors are white, buff, and cream. Chert pods do not dominate any units in the Escabrosa. Richard (1983) in the Little Harquahalas recognizes a tripart sequence in the Escabrosa (Redwall) Limestone with the middle part variably dolomitized, and the two lower parts collectively comprising the cliff-forming part of the formation.

Overlying the Escabrosa Limestone is the very colorful and distinctive Supai Formation. It consists of calcareous, fine-grained quartzites that weather to tan, dark reddish-brown, or black colors. The more massive beds, perhaps 2-5 feet thick, weather to the darkest colors and are characterized by a "worm-eaten wood" appearance. The other, more finely interbedded, variably calcareous units weather to tan or red-brown colors. The Supai has a thickness of about 170 m.

Overlying the Supai Formation is the Coconino Sandstone; it consists of about 200 m of fine- to medium-grained, white, pure quartz arenite, now quartzite, that generally lacks any visible internal bedding and is usually highly fractured. The intense fracturing makes rubbly slopes out of even the best Coconino exposures and renders cross-bedding quite difficult to see. Nowhere else in the stratified sequence does a thick, similar-colored, quartzitic unit occur, thus making the Coconino an easily mappable unit.

Above the Coconino is the Kaibab Limestone, which is a very cherty, fetid, gray to blue-gray, fossiliferous series of limestone beds that is up to 205 m thick in the Quartzsite quadrangle of the southern Plomosa Mountains. Richard (1983) discusses a relatively complete Kaibab Limestone section in the Little Harquahala Mountains that is up to 400 meters thick and consists of five units. Further detailed work in the northern Plomosas would probably delineate units of his Kaibab stratigraphy there.

As mentioned above, an evaporite unit is juxtaposed with the Kaibab Limestone and Mesozoic clastic strata, as judged from details of stratigraphy in the Plomosa Pass area. It may represent the alpha (Harrisburg) member of the Kaibab that is present in the Basin and Range country south of Las Vegas (Bissell, 1969) or it may be an evaporite unit within the Mesozoic volcanic-sedimentary rocks. Its possible regional importance, discussed later, has thus far been overlooked because of the brief, reconnaissance nature of previous work. The evaporite unit consists of white,
coarsely crystalline (recrystallized) gypsum with perhaps some minor anhydrite and with abundant partings and thin interbeds of light to dark green to dark gray laminated mudstones. In places the mudstones attain thicknesses of several tens of feet. Pure gypsum beds within this sequence are 5 to 25 feet thick. The unit weathers as a slope-former, but is characterized by a peculiar popcorn surface of mottled gray, green, and light gray colors, making it easily mappable.

Richard (1983) mapped a 10-20 m thick evaporite-green mudstone sequence in the Little Harquahala Mountains that is lithologically very similar to the northern Plomosa evaporites. The evaporites in the Little Harquahala Mountains occur at the center of the western edge of section 19, T.4N., R.12W., in a south-dipping Mesozoic volcanic-sedimentary sequence. Richard maps the evaporites as stratigraphically above his Jv unit (lower and upper Jurassic volcanics, including a quartz porphyry unit) and an overlying Jv5 unit (volcanoclastic sediments derived from Jv); and the evaporite is beneath his JKau (upper Apache Wash Formation tuffaceous sandstones). A laterally equivalent unit to the evaporites is his JKau unit, (lower conglomerate member) that thins out northward and is replaced by the evaporites. In this stratigraphic context, the gypsum-shales may represent ponded, restricted circulation evaporites formed synchronously with riverine or piedmont gravels, and overlain by some kind of fluviol (braided?) stream deposits.

A gypsiferous unit has been noted in the Harquahala Mountains in the upper reaches of the piedmont, just below the White Marble mine (Peirce, oral communication, 1983). Its stratigraphic position there is not well known, except insofar as it is associated in outcrop pattern with the Kaibab Limestone, as it is in the Plomosa Pass area of the northern Plomosas.

Paleozoic-Mesozoic gypsiferous strata are recognized in adjacent California. In the Riverside Mountains, Lyle (1982, p. 477) notes that a gypsiferous phyllite that directly overlies the Kaibab Limestone "is a very enigmatic unit. In most areas the gypsum does not appear depositional, but rather seems to have been remobilized or generated by later metamorphism and/or hydrothermal activity associated with sulfide mineralization. Sericitic quartzite (Aztec Sandstone?) that overlies the gypsiferous phyllite is locally present in Mesozoic sections." Above the Aztec Sandstone is a section of tuffs, arenites, dolomites, calc-silicate layers, and conglomerates. His only age constraints on the gypsiferous strata are that they are younger than Kaibab and are older than the sericitic quartzite that a few workers are calling the Aztec Sandstone which in its type area is of
early Jurassic age. In the Little Maria Mountains, Emerson (1982) briefly notes that the Kaibab Limestone "plays host to a considerable amount" of gypsum and anhydrite evaporites.

MESOZOIC

A tectonically thinned, fine-grained clastic sequence is here assigned to the Mesozoic; it is most probably correlative with the "continental red beds" of Miller (1970) found in the Quartzsite quadrangle to the south. As in that area, the sequence in the northern Plomosas contains fine- to medium-grained, variably calcareous sandstones and a few quartzite pebble to cobbles conglomerates. As with other stratified units, it is of indeterminate thickness because it is found only in a highly attenuated state in a tectonic melange. The section is now metamorphosed to muscovite-bearing, gray- to silver-colored phyllites or phyllitic mudstones. The unit is found in three parts of the study area - the Plomosa Pass area, south of Round Mountain, and intercalated into the southern volcanic terrain.

Robison (1979), in a M.S. thesis on the Mesozoic clastics in the southern Plomosa Mountains, indicates that these conglomerate-bearing red beds underlie or interfinger with the basal part of the thick Livingston Hills Formation. This 5000 m thick formation consists of conglomerate, graywacke, and siltstone, but is not recognized in the northern Plomosas. Volcanics of Mesozoic age were not recognized in the study area.

Other probable Mesozoic units include a pluton of fine- to medium-grained biotite granite that crops out over an area of about 0.4 square miles near Plomosa Pass, and a related series of northwest-trending aplitic and microgranite to micro-quartz monzonite dikes, which range in thickness from 2 to 50 feet. By regional analogy, this granite is probably 70-85 m.y. old and is assigned a Laramide age. In this report, the granite is called the Mudersbach pluton, named for the mine of the same name that is developed in Paleozoic carbonates that were mineralized by fluids related to the intrusion of the pluton.
Late Oligocene and early Miocene rocks are represented by a lower section of 1) Artillery Formation sediments and associated basal silicic volcanics, 2) an overlying and locally thick section of volcanic flows with basal red beds and andesite flows and overlying rhyolites to latites, 3) overlain by a section of red bed fanglomerates. The youngest sediments are 4) those that fill the present valleys and are herein called basin fill. These are the only tectonically undisturbed rocks in the area.

The Artillery Formation, defined in the type area of the Artillery Peaks about 45 miles northeast of the Plomosas, consists of three major units in the map area. A basal arkose and arkosic conglomerate, up to 30 m thick north of Round Mountain, was called the Bouse Arkose by Jemmett (1966), and is composed of white, red-brown, and green-colored beds of fluvially sorted stream sediments. Clasts are composed of white vein quartz, megacrystic granite, and quartzo-feldspathic gneiss. The rock was mostly derived from a granitic terrain, presumably the Precambrian granite upon which it is deposited in most areas. North of Round Mountain the arkoses contain interbeds of thin andesite flows that are now extremely weathered. Above the arkose is 20-80 m of very colorful (maroon, pink, red, and red-brown), thin-bedded limestones, limy mudstones, and shales characterized by laminar wavy bedding. The limestones contain several unwelded and welded ash flows that are 2-5 m thick. The fine grained sediments weather to a rather uniform surface with pure limestone units (3 inches to 2 feet thick) standing out in bold relief. The sequence thickness is best measured in the area east or northeast from Round Mountain, but even there is only measured with difficulty since all contacts with other units are faulted. Around Four Peaks and in the southern part of the map area, several thin ash flows underlie the Artillery sediments.

The Artillery Formation is separated by an angular unconformity (commonly 5-15 degrees) from an overlying section of volcanics whose internal stratigraphy varies from place to place. In the northern part of the area, the section consists of about 50-150 m of a mixture of dark-colored red beds, some andesite flow breccias, and a series of andesitic volcanics, some of which contain manganese and barium mineralization (barite, psilomelane, etc.). In the southernmost area of the map the section consists of 5-20 m of basal andesites with a thin, basal fluvial unit of red beds; the andesites are overlain by
200-400 m of predominantly cliff-forming, unwelded ash flows with related domes, pyroclastic vents and dike swarms that trend north-south to northwest-southeast. Both in the southern map area and around Four Peaks, the lower part of the volcanic section (usually near the top of the basal andesites) contains many small, discontinuous, megabreccia slide blocks of Paleozoic limestones, including lithologies from Escabrosa through Kaibab. The carbonates sometimes are associated tectonically with thin slivers or masses of megacrystic Precambrian granite. The slide blocks clearly sit on andesite flows in many places. See the 1:24,000 map for details. The problematic aspect of these units is that although the quartzite units are internally fractured, thicker masses of limestones do not contain the typical "crackle breccia" texture that is so common in other megabreccia slide masses that are well documented in southern Arizona. Yet their interleaving into the Cenozoic section is an unmistakable attribute of a landslide origin. The landslide blocks most likely were derived from exposures of Paleozoics to the north, where outcrops still occur.

North of the Plomosa Pass area, a red bed unit occurs above the volcanics and consists mostly of bright red-brown colored, debris flow-dominated fanglomerates. They contain thin vertical clastic dikes (as in NE 1/4, SE 1/4, section 30, T.6N., R.17W.), and barite veins that are subject to continued prospecting (as in center, N 1/2, section 31, T.6N., R.17W.). In one spot, symmetrical ripple marks with a wavelength of 4 cm were found on a sandstone in this red bed unit. Just south of Four Peaks, the red beds appear to thicken, perhaps up to 100-200 m. Thick red beds were not seen in the southern part of the map area, but may have been present in the volcanic mountains. These red beds are most probably correlative with the Chapin Wash Formation around Artillery Peaks and the Copper Basin Formation north of Blythe, both of which have been dated as mid-Miocene (about 14-16 m.y.o.) based on large mammal tracks and age dates on associated volcanics. See Wilt and Scarborough (1981) for a state-wide summary of Cenozoic stratigraphy.

Undeformed basin fill rests with angular discordance upon all older rocks. Exposed parts of this material are probably no older than mid-Pliocene. A strat test hole (Federal La Posa No. 1A) was drilled by El Paso Exploration Company in 1968 in NW1/4, Sec. 24, T.7N., R.19W., about 11 miles due west of Bouse (collar elevation was about 880 feet above sea level). A partial lithologic log indicates that sandstone, gravels, and minor claystone were penetrated in the first 780 feet; followed by claystone and mudstone with gypsum and anhydrite stringers in the interval 780-2020 feet. 'Metamorphic basement complex' was encountered from 2328 to 2815 feet (Total Depth). El Paso geologists identified Bouse
Formation between 850 and 1197 feet, based presumably on differing colors. If this identification is correct, the top of the Bouse Formation is now 30 feet above sea level in this area, indicating that negligible net vertical crustal movements have occurred since the end of Bouse deposition, which was in the late Pliocene or early Pleistocene. This is in contrast to other places along the lower Colorado River trough where the Bouse Formation is now elevated many hundreds of feet above sea level (Lucchitta, 1978).

These basin fill beds are capped by Pleistocene pediment gravels and on the west side of the range on the La Posa Plain are overlain occasionally by light red-brown colored sand dunes, most of which have been arrested by vegetation. The piedmont west of the mountains, the La Posa Plain, is virtually undissected by stream downcutting, except locally in the uppermost reaches of the piedmont. Stream channel bottoms (as in center, section 16, T.6N., R.18W.) are incised perhaps 1-1.5 m. East of the range, near the mountain front, (as in E 1/2, sections 24 and 25,T.6N.,R.18W.) coarse-grained basin fill has been dissected by the north-flowing ephemeral streams as much as 20-25 meters. Farther out into the Ranegras Plain, dissection is minimal, and sheet flooding occurs.

The ages of the Tertiary rocks must be inferred from regional arguments, since only one published age date is known for the volcanics in the northern Plomosas. An ash flow south of Four Peaks (near center, NE 1/4, SE 1/4, section 26, T.6N.,R.18W.) was dated at 26 m.y. by Eberly and Stanley (1978, their number 91). The ash flows beneath the Artillery Formation date at about 20-30 m.y.o. throughout the region (Scarborough and Wilt, 1979; Reynolds, 1980). These volcanics and the Artillery limestones lie beneath an angular unconformity, above which is a younger volcanic pile and red beds that regionally date at about 14-21 m.y.o. Since this unconformity usually caps rocks with 5-15 degree greater dip than the overlying ones, some sort of regionally extensive tilting phenomenon must have been active between 21-25 m.y. ago. It probably took the form of either listric faulting (Reynolds, 1980) or folding.

Where undeformed basin fill has been dated, it is apparently not older than 12-13 m.y. (Eberly and Stanley, 1978; Scarborough and Peirce, 1978) throughout most of southern Arizona; the oldest flat-lying volcanics along the lower Colorado River are also about 11 m.y. old.
GEOLOGIC RELATIONS IN THE NORTHERN PLOMOSA MOUNTAINS

STRUCTURES

The northern Plomosa Mountains are divided on a structural basis into at least six domains or plates that are adjoined by major faults. Very dissimilar rocks have been tectonically juxtaposed during a series of low-angle, probably thrust faulting events and also during a later Cenozoic, gravity-induced, detachment or sliding event. The earlier thrust fault events most likely occurred in the Cretaceous during the Sevier and/or Laramide orogenies and possibly again in the Eocene during an event called the "Eocene underthrusting" by Stanley Keith. Later, during the middle Miocene, a "dislocation" or "detachment" faulting event again juxtaposed terrains, possibly during a gravity sliding event.

As mapped for this report, the plate above the Miocene fault contains a Cenozoic sedimentary and volcanic series deposited across a tilted and erosionally beveled three-plate melange composed of Precambrian, Paleozoic, and Mesozoic rocks. The plate beneath the Miocene fault contains Precambrian, Paleozoic, and Mesozoic rocks tectonized into five-plate melange by earlier thrust faults.

Figure 3 is a general tectonic map of the proposed nomenclature for the structural units recognized in the map area. Assuming that none of the plate stratigraphy is overturned, and relying upon dip patterns of plate-bounding faults, the structural sequence from lowest to highest is: Bighorn plate, Plomosa Pass plate, Tough Nut plate, Deadman plate, and Plomosa plate.

GENERAL DESCRIPTIONS OF LITHOLOGIES WITHIN PLATES

1) BIGHORN PLATE

This plate consists mostly of Precambrian gneissic rocks and contains some granites, diorite, pegmatites, and several pods of a possible metasedimentary sequence. The gneisses display complex refolding patterns, but a general NNE-trending compositional layering predominates. The series
geologic units

Ts Tertiary sediments
Tv Tertiary volcanics
Kg Eocene (3) granite (Mudersbach pluton)
Mz Mesozoic sediments + aquarites
Pz Paleozoic sediments
PEC metagranitic (1.7 by. old)
PEGM 1.7 by. old granites - monzonites.
Pegn- gneissos, amphibolite grade

area of intense
Linited quarts, perhaps
Wisconsin detachment surface
is nearby?

Narrative:

fold axes with probable
Late Tertiary
origin.

fold axes of
Precambrian origin,
confined to within
Bighorn plate.

older thrust faults
Cretaceaus - early Tertiary

mid-Miocene
Detachment Fault.
(reactivated older thrust).

Figure 3. General sketch
Tectonic Map of northern
Plomosa Mountains.

Plate and Fault nomenclature

1 Bighorn plate
2a Plomosa Pass plate - Mz + Pz
2b Plomosa Pass plate - Pz only
3 Tough Nut plate
4a Deadman plate - PEGM + Pegn
4b Deadman plate - Pegn only?
5 Plomosa plate - Tv + Ts
Depositional plate on PEC + Pegn + Pegm.

A Plomosa Pass Fault
B Deadman fault
C Tough Nut Fault
D Plomosa fault
E Plomosa Pass road

about 1 mile
is generally metamorphosed to amphibolite grade. Because these are the structurally lowest rocks present in the map area, they could represent autochthonous basement. However, based on evidence in nearby regions that is discussed later, this may not be the case.

2) PLOMOSA PASS PLATE

The Plomosa Pass plate is a tectonic melange containing thin interleaved slices of many sedimentary rock types including Paleozoic limestones and quartzites, massive gypsum beds mixed with green mudstones, and slates and phyllites of Mesozoic age. It has undergone ductile deformation and greenschist grade metamorphism that has destroyed fossil content of the limestones and produced an impressive set of tight folds. In greater detail, and as seen in Figure 2, this plate may be subdivided laterally into two areas, an eastern area containing exclusively Escabrosa, Supai, Coconino, and Kaibab rocks, and a western area containing all the mapped evaporite occurrences, along with many thin slices of Paleozoic carbonates and Mesozoic phyllites. In addition, the Coconino quartzites, which are so thick and extensive in the eastern area, are represented only by a few, thin, small tectonic slices in the western area. The two areas abruptly join each other along what is probably a covered NE-trending fault. The western evaporite-bearing melange is squeezed to extreme thinness (200 m) precisely at the mountain range divide near the Plomosa Pass road.

MUDERSBACH PLUTON. The rocks of the Plomosa Pass and Bighorn plates are mapped as being intruded by the Mudersbach pluton, a biotite granite of probably Laramide age, exposed mostly south of the Bouse-Quartzsite road. This granite is not foliated or deformed, and therefore is younger than the deformation(s) recorded in the rocks of the Plomosa Pass and Bighorn plates. The granite resembles a finer-grained equivalent of the 85 m.y. old Tank Pass Granite that crops out across the valley to the east. The Mudersbach could alternatively be related to the 70 m.y. old granites of the region such as the Granite Wash granite; it could conceivably be related to the granites of the mid-Tertiary volcanic pulse at about 25 m.y.o. An age date on this rock, or on one of the many NW-trending micro-quartz monzonite dikes would help to clarify the minimum age on the time or times of this older tectonization. An interesting, probably reset, age of 16.5 ± 0.50 m.y. was obtained on the large granite mass shown centered 8 miles east of Bouse on the Arizona state geologic map (Shafiqullah and others, 1980, date number 115). The rock is described as a biotite granodiorite.
Figure 2: GEOLOGIC MAP - PLOMOSA PASS AREA

All symbols from previous map apply, with following additions:

Mev: Mesozoic evaporite - green mudstone sequence
Ms: Mesozoic clastic sediments, rep argillites etc.
G: green quartzite of unknown affinity, Mesozoic?
ls: small limestone stringers of unknown affinity.
Ph: Kaibab Limestone
Ps: Supai Formation
Me: Escabrosa Limestone
Dm: Martin Formation
F: aplite and microgranite dikes
G: pegmatite

Robert Scarborough - 20 Oct 1983

0.5 miles
3) TOUGH NUT PLATE

This a very small plate-remnant of gneisses that have very similar lithologies to the gneisses of the Bighorn plate. The Tough Nut plate is structurally above the eastern extent of the Plomosa Pass plate, where the latter consists almost exclusively of Coconino quartzites. Interestingly, the Tough Nut gneisses contain small, tectonically interleaved, slices and masses of Coconino rocks, and the tectonic contact between the Tough Nut plate and Plomosa Pass plate is smeared with stretched-out slices of Paleozoic carbonates. An alternative structural interpretation is that possibly because of some ambiguous fault relationships in the area, the Tough Nut plate could be a fragment of the Deadman plate. In such a case the northern boundary of the Tough Nut plate could be an extension of the Deadman fault that had been offset northward along the N-S trending fault mapped as the western boundary of the Tough Nut plate.

4a) and 4b) DEADMAN PLATE

The northern part of the Deadman plate (4a) is a subplate composed of gneissic rocks that display an extreme variety of dark and light lithologies, many of which are meta-igneous. At its western extent, the gneisses grade abruptly into a megacrystic granite terrain. Toward their southern extent, the gneissic rocks appear to be structurally bound to subplate 4b), the southern part of the Deadman plate, which is composed of a medium-grained Precambrian granite or quartz monzonite (probably a 1,700 m.y. old Precambrian rock). Subplates 4a and 4b are structurally bound together along a rehealed tectonic contact that is strewn with small, very discontinuous, sometimes en echelon, tectonic slices of predominantly Supai, Coconino, and Kaibab formations.

5) PLOMOSA PLATE

This plate is defined to include all the rocks above the Plomosa fault, which probably experienced its last movement during the mid-Miocene. This "detachment" phenomenon was probably related to a regional listric faulting (tilting) event which is now recognized to have affected much of the Basin and Range province. As noted later, the Plomosa fault probably had an older movement history.

The rocks in the Plomosa plate consist of a stratified
sequence of Cenozoic rocks deposited on top of a tripart plate assemblage that had been previously thrust-juxtaposed, tilted, and eroded to low relief. The three parts of the plate assemblage consist of a lower plate of 1,700 m.y.o. granite, gneiss and diorite; a middle plate of Paleozoic carbonate and quartzite and minor Mesozoic phyllites; and an upper plate of megacrystic granite with some minor gneisses. After the Cenozoic sediments and volcanics were deposited on the upper megacrystic granite plate, all the rocks above the Plomosa fault were involved in a mid-Miocene detachment faulting event. In this event a series of WNW-trending listric faults homoclinal tilted the Cenozoic rocks of the plate, resulting in south-southwest dips on the strata. The listric faults repeat the Cenozoic-on-crystalline stratigraphy four or five times along the eastern side of the northern Plomosas. In the southern part of the map area the upper silicic volcanic sequence becomes very thick, but still retains south-southwest dips; hence, all pre-basin fill Cenozoic rocks of the Plomosa Mountains that are north of the Interstate 10 freeway must have been listrically rotated and therefore are floored by one or more Miocene detachment surfaces, and numerous listric faults that floor in the detachment.

DIKES

Dikes composed of three different lithologies are represented in the northern Plomosa Mountains. The recognized lithologies are a) microgranite, micro-quartz monzonite, and minor microdiorite, b) rhyodacite, and c) aplite. The dikes generally trend northwest and are concentrated in the area around Plomosa Pass. The micro-quartz monzonite dikes are evenly textured, form vertical dikes 1-15 meters thick, and are found beneath the Plomosa detachment fault in the Bighorn, Plomosa Pass, and Deadman plates (plate nomenclature is shown on Figure 3). The rhyodacite dikes trend northwest to north, are 0.5-3 m thick (thicker in volcanic terrain), and intrude the southern volcanic terrain and the granites upon which the volcanics rest. The aplitic (finely crystalline quartz and feldspar) dikes are vertical, 1-5 meters thick, and trend parallel to, and intrude along, the Deadman and Plomosa faults. The aplitic dikes are concentrated in the terrain beneath the Plomosa fault, but are also found above the Plomosa fault in upper plate granites.

The micro-quartz monzonite dikes attain a 15 meter thickness in the northern half of Sec. 26, T.6N., R.18W. At the west end of that swarm the dikes are the host rocks of the black manganese oxide mineralization controlled by
NNE-trending fractures. The micro-quartz monzonite dikes within the western extreme of the Plomosa Pass Plate flared out into horizontally tabular masses and attain considerable thickness there. A few narrow microdiorite dikes are found cutting the Plomosa Pass plate melange. Judging by their cross-cutting relationship to the structural grain, these dikes are clearly post-kinematic. They compositionally resemble the Mudersbach pluton, but no dikes of any composition were noted to lead away from the pluton, hence an ambiguous relationship of intrusive chronology exists.

Because of poor exposures, it was not possible to ascertain whether or not the aplite dikes were emplaced before or after the last movement on the Plomosa fault, even though they intrude along the fault. They are certainly younger than the Mudersbach pluton because they intrude along the Plomosa fault where the fault truncates the pluton at its southeast corner, two-thirds of a mile southeast of the Mudersbach mine. They consistently intruded along the Deadman fault and parallel to it in the gneisses of the Deadman plate. They maintain a consistent northwest trend even though the general structural grain turns from northwest to an east-west direction going westerly and this suggests the aplite dikes were emplaced post-kinematically.

The rhyodacite dikes are limited in outcrop to a band two miles north of the northern outcrop limit of the southern volcanic terrain. Above the Plomosa fault, the rhyodacite dikes trend north-south in the upper plate granites, parallel to the proposed trend of the conjectural part of the Plomosa fault, and the ones found in the southern volcanic terrain trend generally strike parallel to the rotated blocks of volcanics. Beneath the Plomosa fault, in the gneisses of the Deadman plate, they trend east-west in the eastern half of Sec. 2, T.5N., R.18W.

In conclusion, all the dikes, as well as the Mudersbach pluton are judged to be post-kinematic. The rhyodacite dikes are late-stage and probably are the same age as the mid-Tertiary volcanics, while the micro-quartz monzonite and aplite dikes may be late stage Mudersbach pluton or late Mesozoic or mid-Tertiary in age. Shafiqullah and others (1980, No. 62, p. 249) obtained K-Ar ages of $28.6 \pm 1.9$ m.y. and $22.1 \pm 1.3$ m.y. on hornblende and biotite, respectively, from a northwest-trending "diorite" dike in the Harquahala Mountains. Logan and Hirsch (1982) obtained an age of $19.0 \pm 1.2$ m.y. on a dacite porphyry dike in the Castle Dome Mountains that does not cut a detachment fault nor penetrate upper plate volcanics, while another rhyolite porphyry dike, dated at $20.4 \pm 0.6$ m.y., cuts the detachment and upper plate volcanics. Shafiqullah and others (1980) also report two other K-Ar ages from dikes in the region. In
the Cabeza Prieta Mountains, a northeast-trending hornblende andesite dike that cuts the Gunnery Range granite was dated at 17.8 ± 0.6 m.y. (No. 110, p. 254). In the Eagletail Mountains, a biotite latite dike that cuts Precambrian basement and overlying tuffs and vitrophyres was dated at 20.0 ± 0.6 m.y. (No. 93, p. 252). Most likely, the rhyodacite dikes in the northern Plomosas will have an age of 30-15 m.y., based on these dike ages elsewhere.

STRUCTURAL OBSERVATIONS AND INTERPRETATIONS

The nature and timing of structural events within the northern Plomosa Mountains may be discussed using the following salient observations.

1. PLOMOSA FAULT

The general geologic history is best considered by dividing the northern Plomosas into two realms, one above and one below the Plomosa detachment fault. The most important part of the lower plate geology (beneath the Plomosa fault) is exposed in what may be a NW-SE trending anticlinal arch or window, whose axis is shown as the Southern Cross anticline on the 1:24,000 map. Since mapped evidence leads us to hypothesize that the anticline arched the Plomosa fault, the anticline is a very youthful feature, younger than the detachment event, and perhaps 13-15 m.y. in age, based on regional analogs (Reynold, 1980). There are a series of folds and high-angle reverse faults found throughout southern Arizona that were active at about this time, indicating a short-lived, NE-SW directed, compressive pulse just before the initiation of Basin and Range, high-angle, block faulting. It is probable that all the geology observed beneath the Plomosa fault exhibits essentially no trace of the detachment faulting event (except for a small amount of drag of gneissic foliation into parallelism adjacent to the Plomosa fault) and hence is telling us an entirely different story than the Miocene one.

2. ORDER OF STRUCTURAL STACKING

The order of structural stacking beneath the Plomosa fault, and proposed nomenclature for the area, is shown in Figure 3.

3. VERGENCE INDICATORS
In several areas, certain indicators of tectonic vergence were found at or near some of the above faults.

a) Slickenside lineations in the Plomosa Pass fault (structurally the lowest of all the major faults) were found at one locale which indicated an older SE plunge superimposed by a younger SW plunge.

b) Sediments within the Plomosa Pass plate contain small rooted "S" and "Z" fold axes trending S10-55W with indicated vergence of SE to E, and long-axes trends on stretched quartz pebbles of S55E, implying NW-SE transport. A few scattered NE vergent folds were also noted.

c) Paleozoic limestones in an outcrop of tectonic melange above the Plomosa detachment fault (in the Plomosa plate but possibly representing an exotic part of the Plomosa Pass plate) contain a beautiful example of some "S" folds with SSE vergence. This area is very near the center of NW 1/4, section 31, T.7N.,R.17W. in a saddle along the crest of the Paleozoic outcrop there.

d) Along the Deadman fault, limited data (such as a few NE plunging slickenside lineations and a few small folds above and below the fault) indicate NE vergence on this structure. Also, away from the Deadman fault throughout the eastern extent of the Plomosa Pass plate, several NE vergence indicators were noted.

e) Slickenside plunge directions in three areas along the northern part of the Plomosa fault indicate NE - SW movement. Tectonic transport during Miocene detachment of rocks above the fault, however, is more NNE, based on the average SSW dip directions of listrically faulted, stratified Tertiary rocks; transport was more ENE in the extreme northern part of the range, just west of the town of Bouse.

4. MOVEMENT ON PLOMOSA FAULT

The Plomosa fault has experienced at least two periods of movement, probably under very different conditions, based on the following reasoning. A relatively easily mapped, generally east-dipping fault, the Plomosa fault, probably represents brittle failure and regional gravity-induced detachment in Miocene time. However, beneath the detachment fault for a variable distance (0-50 m) exists a tectonic zone that sits structurally on the gneisses of the Bighorn plate.
and consists of tectonically interleaved lenses of Paleozoic carbonates and quartzites with gneisses. Individual slices range in thickness from 0.5 to perhaps 3 meters. This phenomenon is well exposed in the SW 1/4, section 19, and adjacent NW 1/4, section 30, T.7N.,R.17W., just west of Round Mountain. The slices are oriented rather parallel to the general trend of the Miocene fault surface, but in some cases they exhibit tight isoclinal folding. The carbonates are clearly interleaved and severely tectonized and stretched, and not simply brecciated. This indicates that this tectonization took place under considerable confining pressure, and not as a near-surface, brittle phenomenon. Sparse vergence indicators, perhaps not enough to be meaningful, suggest SSW vergence for this earlier movement on the Plomosa fault. That the detachment occurs at or near the top of a tectonized zone indicates that the Miocene breakaway occurred along the old zone, which may well represent an older thrust zone, similar to that proposed for the rehealed tectonic contact between the upper and lower Deadman Plate contact.
Figure 4. Geologic Cross-Section of the Plomosa Mountains
ECONOMIC GEOLOGY

The northern Plomosas contain two mineralized areas that appear on the Keith and others (1983) map of mineralized areas of Arizona. These are the Northern Plomosa and Central Plomosa mineralized areas. The district total production of these two areas are given in Table 1 and are compared to two other nearby mineralized areas. Serious mining commenced in the region in the very early 1900's following the completion of the Arizona and California Railroad through Bouse (Keith, 1978, p. 67). The route is shown on the geologic map in Lee (1908).

BASE AND PRECIOUS METALS

The northern Plomosa mineralized area is centered about 4 miles northwest of Bouse, and consists of 9 mines with recorded production, operated between 1901 and 1955. Ores were chiefly copper-gold with silver and minor lead; the ores were contained in specular hematite-manganese oxide gangue host, invariably filling faults or shears. Mineralization is confined, with few exceptions, to above the Plomosa detachment fault, in the highly faulted terrain mapped by Jemmett (1966). One small copper-hematite deposit beneath the Plomosa detachment fault is the Sidehill mine of Jemmett, near the center NW 1/4, section 30, T.7N., R.17W.

The largest tonnage mine was the Little Butte mine that produced nearly two-thirds of the district total gold. Mineralization is accompanied by iron-manganese gangue minerals, and consists of pods and stringers along a single major NNE trending fault and several minor NW trending faults that juxtapose Tertiary shales, limestones, and tuffs with Precambrian gneiss (Jemmett, 1966, p. 108). Keith (1978, p. 170) describes severe brecciation and deep oxidation conditions. Gold values in the Northern Plomosa mineralized area are the highest of any in Table 1, reaching 0.68 oz/ton. Silver values district-wide averaged 0.98 oz/ton.

The Central Plomosa mineralized area contains five mines with recorded production, operated between 1907 and 1951. This area is in the four-mile wide zone adjacent to and south of the Bouse-Quartzsite road. The area was mined primarily for lead and zinc with minor silver (2.9 oz/ton). Gold averaged about 0.03 oz/ton. The Southern Cross mine (Lead Camp of Bancroft, 1911) was the largest producer in the area, and was solely responsible for the area's zinc production,
and most of the lead. Mineralization here is along faults and fractures mostly confined within Paleozoic carbonate blocks floating in a mass of mid-Tertiary volcanics, with presumed mid-Tertiary timing on mineralization. The smaller Climax mine group, 2 miles farther southwest, has metal ratios very similar to the Southern Cross mine, as does the Keiser barite mine, farther south yet. The Excelsior (Mudersbach) mine produced copper-silver ore with minor gold between 1910 and 1930. This production came from replacement bodies in Paleozoic carbonate host rocks that are within 300 meters of the edge of the intrusive Mudersbach pluton. This mine is the only one in the Central Plomosa mineralized area whose production is dominated by copper rather than lead-zinc, and may represent a Laramide mineralization system rather than mid-Tertiary. Grossular garnet-specularite-calcite skarns are locally abundant along lithologic or structural boundaries within the carbonate-quartzite masses.

Other scattered areas of base-precious mineralization are known in the northern Plomosas. Traces of copper-lead mineralization with gangue manganese-iron are seen on the south flank of Four Peaks, the south flank of Round Mountain (section 19, T.7N., R.17W.) along with yellow fluorite, along a northwest trending shear zone (near center, section 15, T.6N., R.18W.), and elsewhere.

FERROUS METALS

Iron

Iron ore was shipped from one property. In 1917, 19 freight cars of 61% iron ore (8% silica, low sulfur, low phosphorus) were shipped from the Phoenix and Yuma mine groups, one-half mile northwest of the Excelsior (Mudersbach) mine (north central part, section 6, T.5N., R.17W.) from what is reported by Keith (1978, p. 170) as "stringers and massive replacement bodies of hematite in a faulted complex of metamorphosed ... limestone, and Precambrian gneiss and schist".

Manganese

Manganese was produced in the northern Plomosas from four properties. The Black Chief and Cindy mines, one mile west of Round Mountain (along the junction between sections 24, T.7N., R.18W., and 19, T.7N., R.17W.) produced collectively about 2100 long tons of +20% Mn ore in 1953 from shear zones in the Plomosa detachment fault. The Black Bird mine group, one mile east of Bouse (SE 1/4, section 24, T.7N., R.17W.)
produced about 3470 long tons of + 20% Mn ore from fracture zones in Miocene andesite porphyry and tuffaceous agglomerates. And in the southern part of the map area, the Black Beauty mine (NE 1/4, section 34, T.5N., R.17W.) produced 490 long tons of + 20% Mn ore in the early 1950's, from along brecciated shear zones cutting the Tertiary andesite-tuff sequence (Keith, 1978, p. 166-168).

INDUSTRIAL MINERALS

Barite

Barite with admixed fluorite has been mined from veins generally cutting mid-Tertiary andesitic volcanics or redbeds. Three mines with known production are the Black Mountain mines group, 4 miles north of Bouse (center, section 34, T.8N., R.17W.) with 2500 tons produced, the Happy Day No. 3 mine (center, section 31, T.7N., R.17W.) with 100 tons produced, and the Keiser barite mine (east central, section 21, T.5N., R.17W.) with small amounts of high grade barite produced (Keith, 1978, p. 167-169). Assays on mined barite concentrates from these deposits indicated between 3 and 14% contained fluorite. Exploration for barite continued into 1982 in and around NE 1/4, section 36, T.6N., R.18W., 1.7 straight line miles northwest of the Mudersbach mine. Vertical veins to 0.3 m thick that cut redbeds were being exposed by bulldozer scraping.

Bentonite

A few hundred tons of swelling type bentonitic clay were mined from a shallow quarry in young altered tuffaceous sediments east of Bouse in west central part of section 25, T.7N., R.17W., for use as a local drilling mud (Keith, 1978, p. 166).

URANIUM POTENTIAL

There are three known areas of anomalous radioactivity in the northern Plomosas. Anomalous radioactivity occurs in the center NE1/4, Sec. 13, T.6N., R.18W., (Rayvern claims, US AEC PRR-AP-348), in a steeply dipping section of limestones and shales of probable Paleozoic age. An incline shaft noted on the 15' quadrangle was sunk probably in search of copper at the site. The radioactive horizon, a very light-colored shale bed about 1 meter thick, has radioactivity characteristic of 0.05-0.10% uranium, but is too limited in extent to warrant further exploration. Nearby in the center
hematized fault gouge in Miocene redbeds rich in granitic debris is locally very radioactive (to 15x). And several thin limestone beds in the Tertiary shale-limestone-tuff sequence, correlative with the Artillery Formation in the Date Creek basin, contain 3x radioactive anomalies in several areas around Round Mountain (Scarborough and Wilt, 1979, p. 61). Judging from the general nature of these anomalies, the overall potential for uranium is judged to be low.

PETROLEUM POTENTIAL

This study was originally funded as an attempt to better understand the oil and gas potential of the Plomosas, in light of the recently hypothesized, regionally important "overthrust belt" concept that has been successfully drilled for oil in Wyoming and Chihuahua, Mexico. The hypothesis states that petroleum traps may exist in sedimentary strata that were buried beneath impermeable crystalline plates during a low-angle thrust-faulting event of Cretaceous or Laramide age. Drewes (1978) and Anschutz (1980) hypothesize that this belt of deformation extends through southern Arizona and connects the more certainly documented areas of thrusting in Wyoming and Chihuahua.

This study has documented the presence of telescoped cratonic Paleozoic and Mesozoic sediments with various crystalline rocks, comprising a stacked thrust assemblage in the northern Plomosa Mountains. However, the metamorphosed character of the sedimentary rocks robably precludes the possibility of any petroleum potential in these rocks. However, because of the stacked nature of the geology extending to an unknown depth, there may be potential for natural gas. Source beds for hydrocarbons are probably limited to various sands and evaporite-rich rocks that are seen in the Mesozoic section. Paleogeography and degree of telescoping are sufficiently unknown to exclude proper source rocks from being present, and perhaps buried beneath exposed structural levels. The best exploration tool is probably seismic profiling, assuming that thrust faults will be good reflectors, and that buried faults and folds will be present to act as traps.
REFERENCES CITED


Heard, H. C., and Rubey, W. W., 1966, Tectonic implications


Lucchitta, Ivo, 1979, Late Cenozoic uplift of the southwestern Colorado Plateau and adjacent lower Colorado River region: Tectonophysics, v. 61, p. 63-95.


