GEOLOGY AND GEOCHRONOLOGY OF THE SIERRA LISTA BLANCA, 
CENTRAL SONORA, MEXICO: A PROGRESS REPORT

Claudio BARTOLINI (1), Mariano MORALES (2), Paul DAMON (3) and Muhammad SHAFIQULLAH (3)

(1) : 2937 W. 21 St Place, Yuma, Arizona 85364, U.S.A.
(2) : Departamento de Geología, Universidad de Sonora, Hermosillo, Sonora, Mexico.
(3) : Department of Geosciences, University of Arizona, Tucson, Arizona 85719, U.S.A.

ABSTRACT

The Sierra Lista Blanca in Central Sonora, Mexico, is formed by the following lithostratigraphic units: a) the Barranca Group (Upper Triassic), which consists of conglomerate, siltstone, sandstone, and shale with fossil plants, b) the Baucarit Formation (Lower-Middle Miocene?), characterized by a conglomerate made up mainly of volcanic and minor intrusive and sedimentary clasts, and c) the Lista Blanca Formation, which consists of agglomerate, tuff, and spherulitic vitrophyre, calcic-latite and rhyolite-rhyodacite flows. Isotopic dating of calcic-latite yielded 10.4 ± 0.2 m.y. This is the first geochronologic age provided from this volcanic sequence. Conclusively, the Lista Blanca volcanics are Tertiary, not Jurassic.

Extensional deformation is expressed by NE-SW and NW-SE trending, high to moderate-angle, planar normal faults. Blocks are tilted to the west-southwest. The structural pattern and tilting produced by block-faulting were generated during the Late Cenozoic development of the Basin and Range Province and the opening of the Gulf of California.

An event of NE-oriented strike-slip faulting is also recorded in the Sierra Lista Blanca. These faults appears to post-date the block-faulting episode. Faulting began after about 10.4 ± 0.2 m.y., but the onset and chronology of faulting events is not precisely constrained. This episode of strike-slip faulting cannot at this time be placed within a tectonic framework.

INTRODUCTION

The Sierra Lista Blanca is located 7 km south-west of San Marcial (fig. 1) in central Sonora, Mexico. This mountain was first studied by Dumble in 1900. He described the stratigraphic units fairly well, recognizing the presence of Late Triassic strata overlain by a conglomerate, succeeded in turn by volcanic rocks. Dumble grouped the conglomerate and the volcanic sequence into the so-called Lista Blanca Division and assigned a tentative Jurassic age based on a supposed transitional contact with the underlying Late Triassic Barranca Group.

King (1934) also visited the outcrops in the Sierra Lista Blanca and thought they were probably originated during a Mesozoic marine cycle. In 1939, King returned to this locality and this time, he suggested that a Mesozoic or Tertiary age for the volcanic successions was likely. For unknown reasons, the Jurassic age proposed by Dumble always had the widest acceptance.

In 1989, while carrying out research in the Paleozoic regions of central Sonora, we discovered that the conglomerate unit overlying the Triassic rocks in the Sierra Lista Blanca was the Baucarit Formation. This unit had long been known to be a Tertiary age and therefore the expected age for the volcanic rocks resting on the conglomerate might in fact be contemporaneous or relatively younger than the Baucarit. Considering these relevant aspects, we decided to conduct further field and geochronologic studies in this region. A geologic map is under preparation.

STRATIGRAPHY

Because the rocks that constitute the Sierra Lista Blanca are very well known in Sonora and are elsewhere well-described by several authors, here we will merely summarize the relevant stratigraphy (fig. 2).

a) Barranca Group - The oldest rocks in the Sierra Lista Blanca are Late Triassic in age and possibly belong to the Santa Clara Formation of the Barranca Group. Good exposures are found along the road from San Marcial to Rancho Ojo de Agua.
The stratigraphy generally consists of dark gray silstone and shale; very coarse-grained, conglomeratic, pinkish quartzarenite; conglomerate composed of subangular and subrounded clasts of Paleozoic chert and quartzarenite; and black fissile argillite containing abundant fossil floras. The plant specimens we collected were identified by Dr. Sidney Ash (weber State College) as: Asterotheca sp., Macrotaeniopteris sp., and Pterophyllum sp. of Late Triassic age (Carnian).

This age is concurrent with previously published ages for the same successions in other localities of central Sonora (Alencaster, 1961; Silva, 1961; Weber, 1985; Stewart and Roldan-Q. (in press).

b) Baucarit Formation - This unit, which is a conglomerate probably more than 150 m thick, forms the bulk of the Sierra Lista Blanca. The conglomerate is highly indurated, poorly sorted, thin-bedded to massive, and light brown-beige in color. It is composed principally of various kinds of volcanic clasts, with minor granite, slate, and quartzite fragments, all embedded in a sandy matrix. Thin, yellow ash tuff layers are common at all levels within the conglomerate, but they apparently
are more abundant at the very top of the section. The intercalation of tuffs throughout the conglomerate is indicative of continuous explosive volcanic activity during sedimentation.

The composition of the clasts seems to indicate that slate and quartzite derived from the underlying Triassic strata. Granite clasts may have possibly derived from the Sonoran batholith (Damon et al., 1983). Volcanic clasts, on the other hand, may have been shed by diverse extrusive sources, perhaps of widely differing ages.

The Baucarit Formation unconformably overlies the Upper Triassic strata.

These later rocks are in turn overlain by vesicular, porphyritic, dark-brown calcic-lutite, with plagioclase phenocrysts up to 2 cm long. The basal part of this flow is characterized by a spherulitic vitrophyre. K-Ar dating of plagioclase crystals from the calcic-lutite yields an age of 10.4 ± 0.2 m.y. (Morales et al., 1990).

The uppermost part of the section is comprised of another rhyolitic-rhyodacitic flow. Our estimated thickness for this volcanic sequence is 50 or 60 m. A consistent thickness is difficult to assess due to lateral attenuation of the volcanic beds.

The stratigraphic contact between the Lista Blanca Volcanics and the Baucarit Formation is concordant. Only for this occasion, the name "Lista Blanca Formation" is being kept. In future publications, we will only refer to the Baucarit Formation and its volcanic associations.

Tertiary volcanic rocks commonly occur underlying, intercalated with, or overlying the Baucarit Formation in many localities in Sonora, Mexico (unpublished information, 1990). However, these volcanic sequences should not be separated as different lithostratigraphic units from the Baucarit. On the contrary, because volcanic activity was intimately associated with crustal extension and syntectonic sedimentation during the evolution of the Basin and Range Province in northwestern Mexico, both lithologies should thus be regarded as a single formation (the Baucarit).

**FAULTS AND FAULT GEOMETRY**

The Sierra Lista Blanca was extended and aligned to the northwest during the processes of Basin and Range formation in the latest Cenozoic. The structure of this terrane is dominated by sets of NE and NW oriented normal faults and a family of NE trending strike-slip faults.

The major phase of structural deformation is represented by planar normal faults (fig. 3a and 3b). These structures strike NE-SW and NW-SE, and normally dip to the east-northeast and west-southwest. Blocks are tilted 20 to 25° to the south-southwest. Locally, en echelon faulting patterns are developed by thin tuffs within the conglomerate. Gash veins on the other hand are more clearly seen in the Lista Blanca tuff.

Fault-planes display slickensides and striations, as well as breccia and gouge materials.

A minor interval of strike-slip faulting distinguished by northeast-striking faults also affected the rocks in this area. The magnitude of lateral displacement is minimal, and no significant offsets were observed. Both episodes of faulting are younger than 10.4 ± 0.2 m.y., but the initiation and mechanical relationship between the different families of faults is not determinable at this point. Untilted striations, on the other hand, suggest that normal faulting was succeeded by strike-slip faults.

Structural style, fault geometry and kinematics were governed by the same geodynamic processes that prevailed during the evolution of the Basin and Range in northern Mexico and the western United States.

**REGIONAL PERSPECTIVE**

Timing and correlation of faulting episodes are difficult because fragmentary pieces of work are the only sources of information concerning the Tertiary structural development of the extended terranes of Sonora, Mexico. For instance, Gastil and Krummenacher (1977) determined the timing of extensional faulting along the coastal Sonora, between Puerto Lobos and Bahia Kino as having occurred after 17 m.y., but before 9 m.y. Evidently, this event pre-dates the deformation at Sierra Lista Blanca.

Detailed studies in the metamorphic core complex near Magdalena (Nourse, 1988; Nourse, 1999) indicate the existence of mid-Tertiary block-style faulting along both northeast and northwest trends.

Regional mapping in the vicinity of Caborca and Altar, Sonora, by De Jong et al. (1988) suggests that high-angle faulting (also regarded
LISTA BLANCA FORMATION

(10.4 ± 0.2 M.a.)

BAUCARIT FORMATION

(LOWER—MIDDLE MIocene ?)

BARRANCA GROUP

(UPPER TRIASSIC)

FIG. 2—STRATIGRAPHIC COLUMN OF STUDY AREA
as Basin and Range faulting) is responsible for the generation of local sedimentary basins. Neither Nourse, nor De Jong provide a tight age constraint for this deformational episode that could be used comparatively.

Henry (1989) concluded that the majority of faulting along the Gulf of California postdates after 17 m.y. He also sees the possibility of diachronic faulting events.

Undoubtedly, the structural style, syntectonic sedimentation and bimodal volcanism in the Sierra Lista Blanca fit into the regional geodynamic model for the Basin and Range Province of western North America (Stewart, 1978).

More intensive field work and more geochronologic data are crucial to better understand the specific conditions of Basin and Range evolution in this part of the state.

CONCLUSIONS

The Sierra Lista Blanca is formed by Upper Triassic strata of the Barranca Group, Lower-Middle Miocene (?) rocks of the Baucarit Formation and 10.4 ±0.2 m.y. volcanic sequences of the Lista Blanca Formation.

Extensive block-style faulting occurred sometimes after 10.4±0.2 m.y. This event of faulting represents the major deformational episode in the area and is characterized by NE-SW and NW-SE trending, moderate to high-angle faults and west-southwestward tilted blocks. Strike-slip faulting was also recognized. This set of NE-striking faults apparently postdates the normal faults, as suggested by the untitled fault striations. Horizontal displacement along these faults is negligible.

Structural styles in the Sierra Lista Blanca are intrinsic to Basin and Range evolution and the rifting of the Gulf of California.

REFERENCES CITED


NOURSE, J., 1989, A thermal-gravitational driving mechanism for Middle Tertiary extension in northern Sonora, Mexico. G. S. A. Abs. with programs, V. 22, nº 3, p. 73.


PIG. 3a, 3b - NORMAL FAULTING AND TILTING OF SIERRA LISTA BLANCA