Iron-Ore Mirror Exchange in Formative Mesoamerica

One of the most interesting discoveries made at La Venta, Tabasco, was a series of large, parabolically concave mirrors made of three types of iron ore: magnetite, ilmenite, and hematite (Drucker, Heizer, and Squier 1959). Garniss Curtis (1959), who determined the gross petrological characteristics of the mirrors, placed their probable point of origin somewhere in the "metamorphic and granitic province" of the state of Oaxaca (Curtis 1959: Figure 80).

In 1966, Flannery (1968) excavated a residential ward at San José Mogote in Oaxaca which was producing small, flat iron-ore mirrors. Michael Coe's discovery of identical mirrors at San Lorenzo, Veracruz (Coe 1968), led Flannery to suggest an exchange relationship between the two areas, based in part on San Lorenzo's importation of Oaxaca mirrors (Flannery 1968:106). That suggestion, however, remained to be confirmed by physicochemical studies on the sources of iron. Moreover, it dealt only with the small flat mirrors, all of which date to the Early Formative (San José phase in Oaxaca, and San Lorenzo and Nacaste phases in Veracruz). The large concave mirrors, which have been found only on the Gulf Coast, date mainly to the Middle Formative (construction phases II-IV at La Venta), although there is one small concave mirror from pyramid fill at Early Formative San Lorenzo.

My study, briefly described next (and more fully documented in Pires-Ferreira n.d.), confirms the fact that small flat mirrors from Valley of Oaxaca sources were traded over great distances during the Early Formative, although access to the mirrors may have been restricted to an elite. The large concave mirrors, however, seem to be largely a Gulf Coast development, which reached its peak in the Middle Formative. Indeed, the small flat specimens and the large parabolic specimens may have had very different functions, a point perhaps obscured by lumping tham all together under the name "mirror."

Mössbauer Spectrum Analysis

Recent developments in the instrumentation for Mössbauer spectroscopy, and the large number of carefully executed fundamental studies of magnetites (Evans 1968), ilmenites (Greenwood and Gibb 1971; Shirane *et al.* 1962), and hematites (Artman, Muir, and Wiedersich 1970) using this technique made conditions rather propitious for the application of Mössbauer spectroscopy to a study of the iron-ore sources and mirrors from archeological sites in Mesoamerica. Mössbauer spectral analysis of 25 geological sources and 38 archeological iron-ore samples was completed in collaboration with B. J. Evans of the Department of Geology and Mineralogy, University of Michigan. A report by Evans on the techniques and procedures used in analysis of these samples is included in Appendix II of Pires-Ferreira (n.d.).

A systematic survey of all potential iron-bearing geologic zones in the Valley of Oaxaca was completed during a 5-month period in 1967; surveys in the Isthmus of Tehuantepec, the Central Depression of Chiapas, and the Valley of Morelos also were completed in 1968 and 1970. In the Valley of Oaxaca, 36 major surface exposures of iron ore were discovered, but only sources that were suitable for mirror production were analyzed (Figure 10.10).

In order to simplify the referencing of spectra, the iron ores studied by Mössbauer analysis were divided into the following five general groups: I, samples composed mainly of magnetite; II, samples of relatively pure hematite; III, samples of ilmenite; IV, samples containing a mixture of magnetite and ilmenite; and V, samples composed of a mixture of magnetite and hematite. In the case of the archeological samples, these groups were later subdivided (e.g., I-A, I-B) according to the geologic source from which they most probably had come.

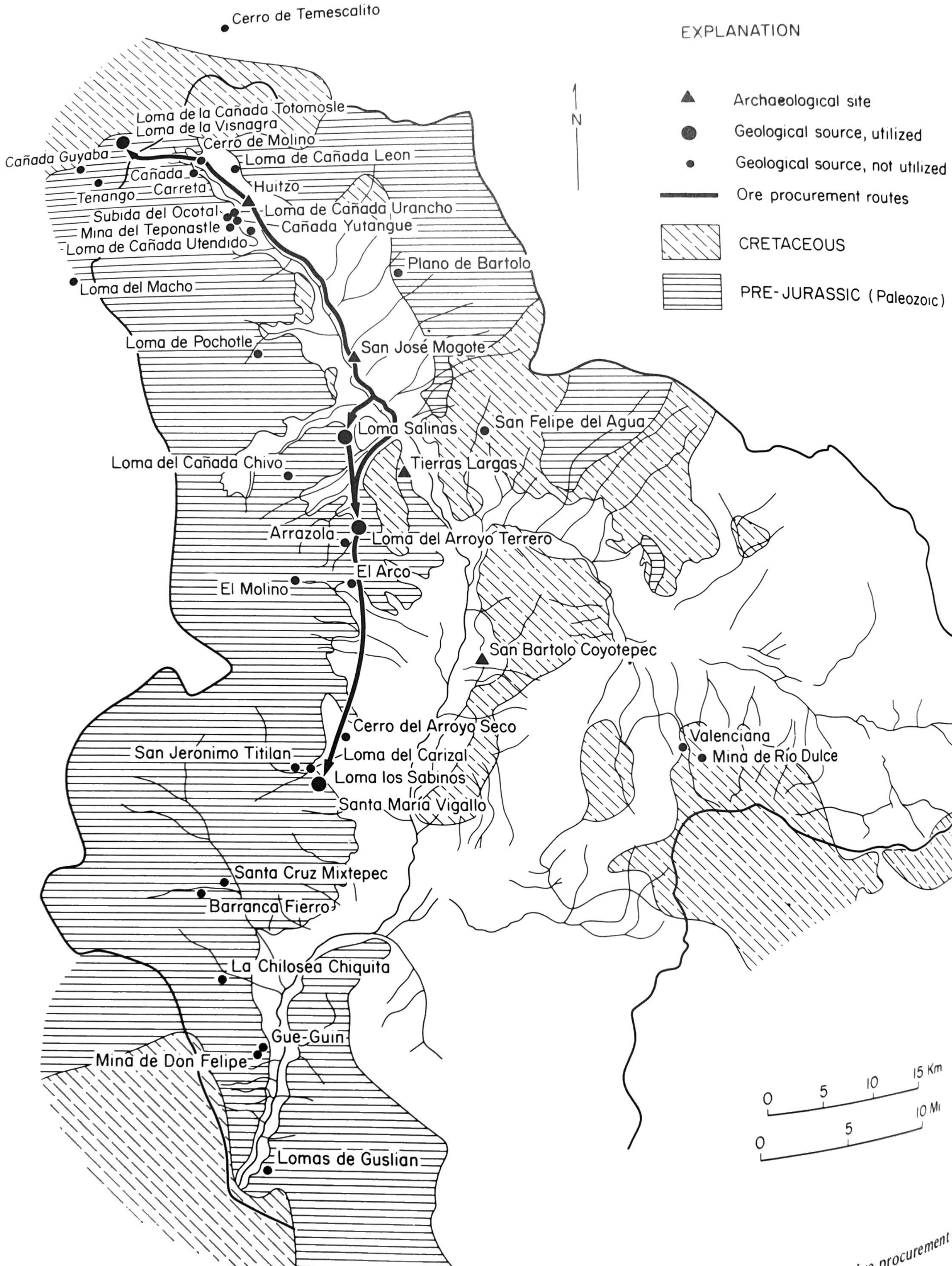


Figure 10.10 Geological sources of iron ore in the Valley of Oaxaca and probable Early Formative procurement routes.

Our sampling studies show that there is virtually no variation in the major phase composition of ore throughout a geological source. Once this was established, the probability of accurately identifying the geologic origin of mirror ores was greatly increased.

Archeological samples from the Early Formative sites of San José Mogote (Figure 10.11), San Bartolo Coyotepec, and Tierras Largas in the Valley of Oaxaca; Etlatongo in the Valley of Nochixtlán; San Pablo, Morelos; and San Lorenzo, Veracruz, were analyzed. Middle Formative samples come only from La Venta, Tabasco; Las Choapas, Veracruz; and Amatal, Chiapas. Several spectral details were used in matching the archeological and geological source samples. For the magnetite samples, the relative intensity and separation of the doublet structure of the peaks in the extreme negative velocity region were used to distinguish between the various sources that make up this group. For mirrors containing hematite and ilmenite, the spectra are so distinctive that the choices are obvious. For the mixed magnetite and ilmenite group, the presence of magnetite is evidenced by the doublet structure in the region of the high channel numbers. In some cases, a significant amount of titanium has dissolved in the magnetite, and the doublet structure has been reduced to a strong outer peak and a weak inner peak. The relative intensity of these two peaks, however, serves to distinguish sources (see Figure 10.12).

All groups defined by my study are discussed in detail in Pires-Ferreira (n.d.). In this chapter I will briefly summarize the most important groups, as follows.

Group I-A is a quite pure magnetite which presents inclusion-free faces ideally suited for mirror making. It includes 10 Early Formative ore lumps or mirror fragments from San José Mogote, Oaxaca, and 1 Early Formative ore lump traded to San Pablo, Morelos. The spectrum matches ore from the twin sources of Loma de Cañada Totomosle–Loma de la Visnagra, near Santiago Tenango, 27 km north of San José Mogote (Figure 10.13).

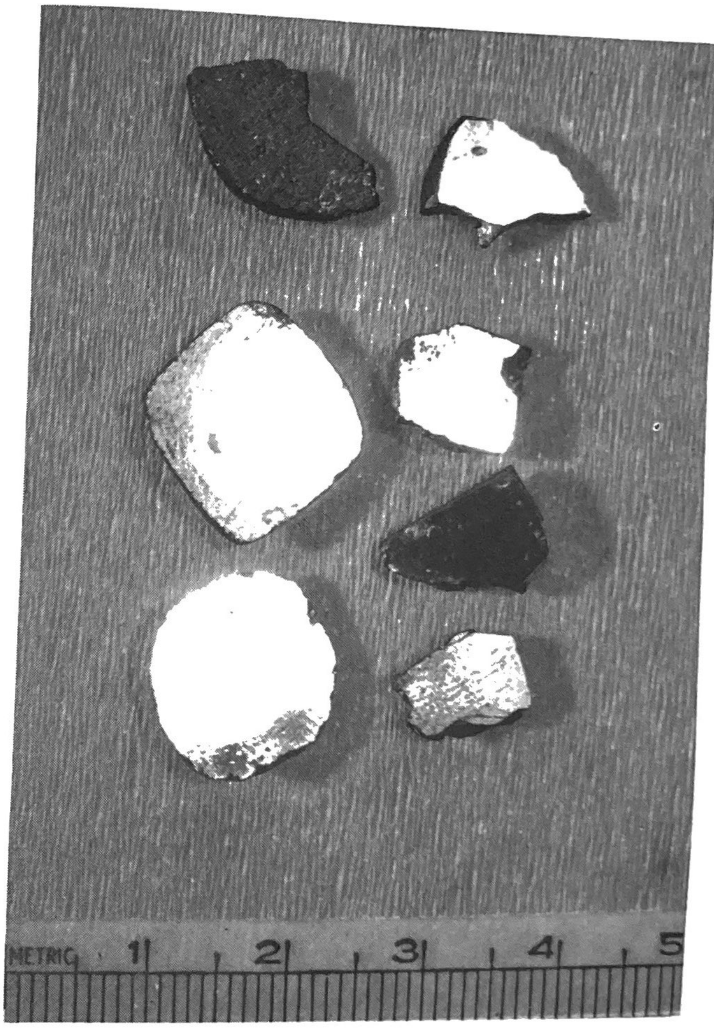


Figure 10.11 Magnetite mirrors and mirror fragments from San José Mogote, Oaxaca. Scale in cm.

Group 1-B is a magnetite with slight ilmenite contamination, very compact and suitable for mirror making. Its spectrum matches the source at Loma los Sabinos, near Zimatlán, 33 km south of San José Mogote. The group include five Early Formative lumps or mirror fragments from San José Mogote, one sample from Coyotepec in the Valley of Oaxaca, and one mirror traded to Etlatongo in the Valley of Nochixtlán, Oaxaca (Figure 10.13).

Group I-C consists of a single large, concave, scalloped-edge magnetite mirror from Middle Formative La Venta, whose spectrum does not match any source we have collected.

Group II-A is a dense, compact hematite ideally suited for mirror making, and tentatively identi-

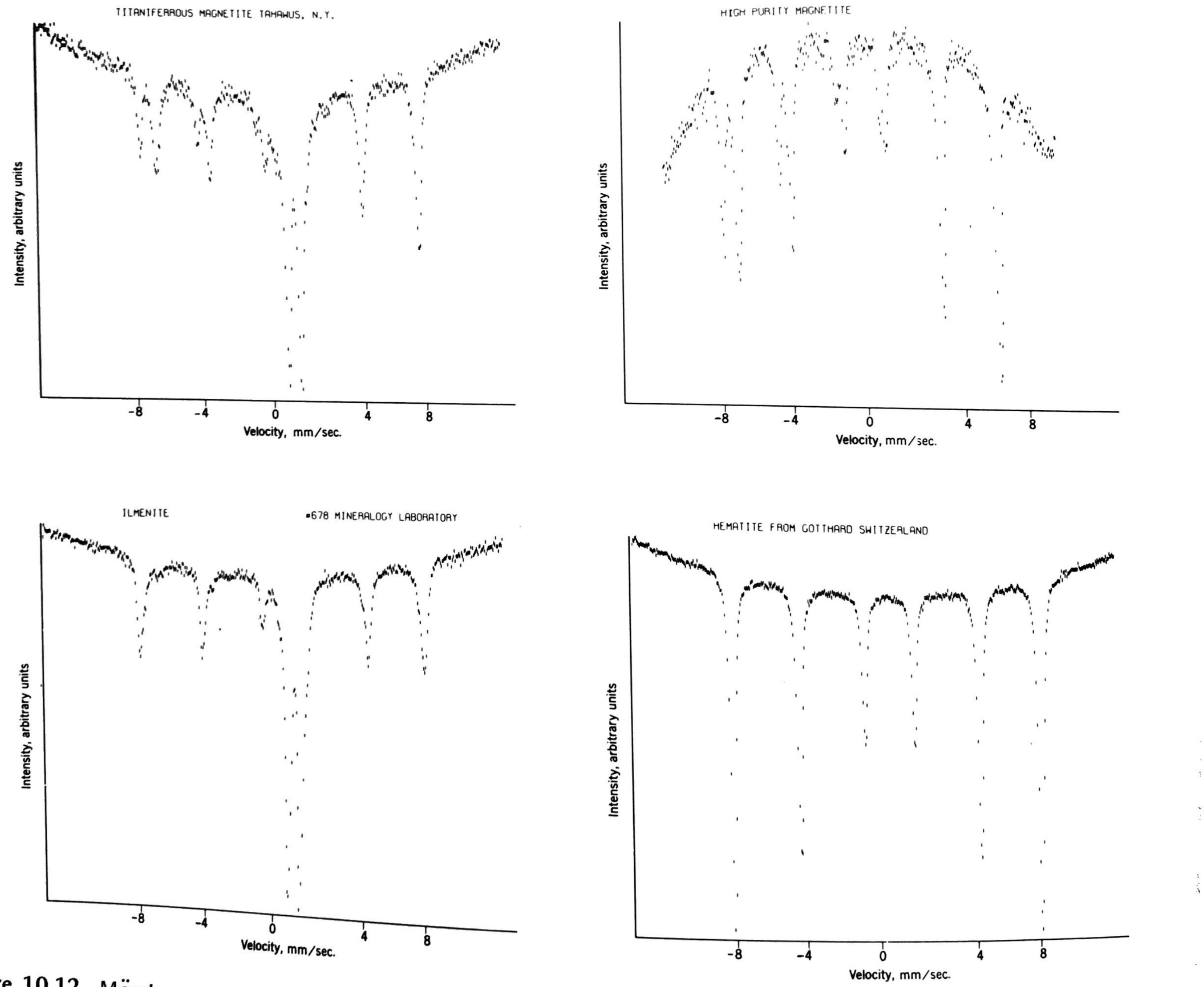


Figure 10.12 Mössbauer spectra of four different iron ore types. From upper left to lower right: titaniferrous magnetite; high purity magnetite; ilmenite; and hematite. [Courtesy, B.J. Evans.]

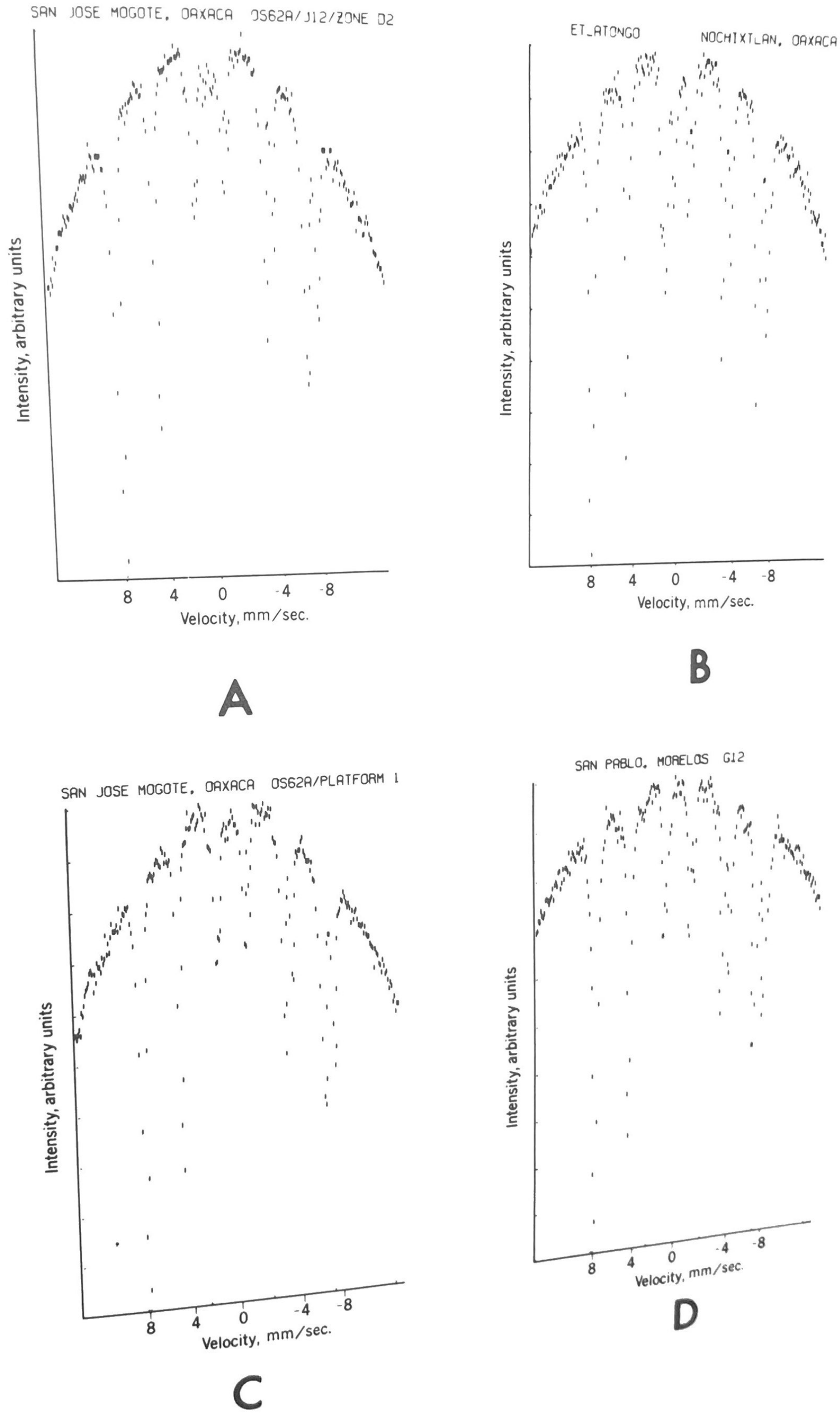
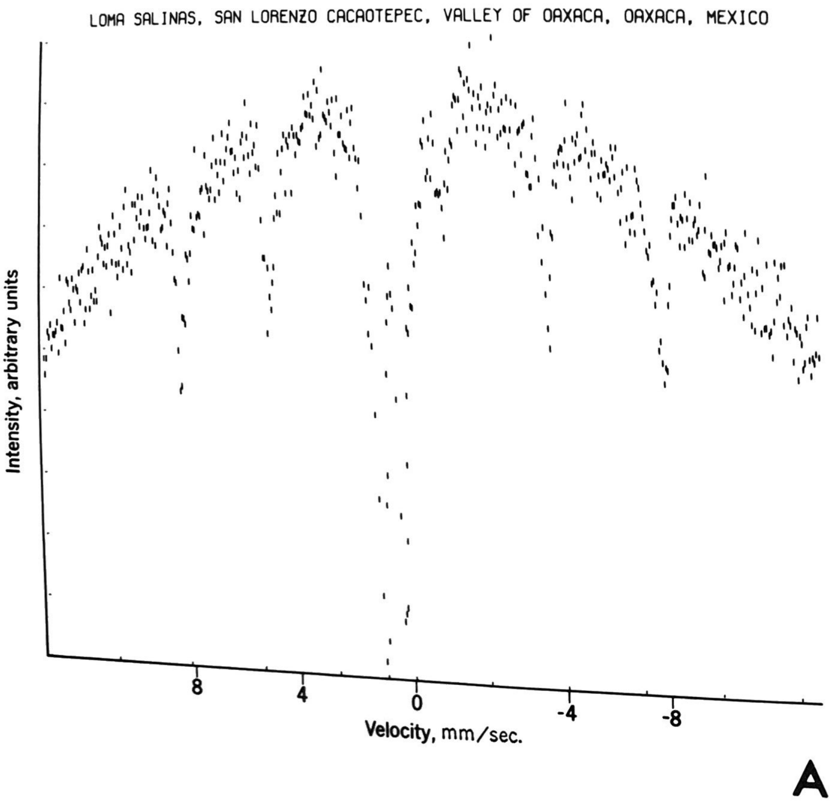


Figure 10.13 Mössbauer spectra of magnetite samples from Early Formative villages. (A and B) Group I-B (source: Loma los Sabinos, Valley of Oaxaca); (C and D) Group I-A (source: Loma de Cañada Totomosle–Loma de la Visnagra, Valley of Oaxaca). A and C are from San José Mogote; B is a small mirror traded to Etlatongo, Nochixtlán Valley; D is an ore lump traded to San Pablo, Morelos.

fied as coming from the source at Cerro Prieto, near Niltepec, Oaxaca, in the Isthmus of Tehuantepec. The group includes two thick flat mirrors from Nacaste phase levels at San Lorenzo, Veracruz, and two large concave mirrors from Middle Formative La Venta (Figure 10.14).



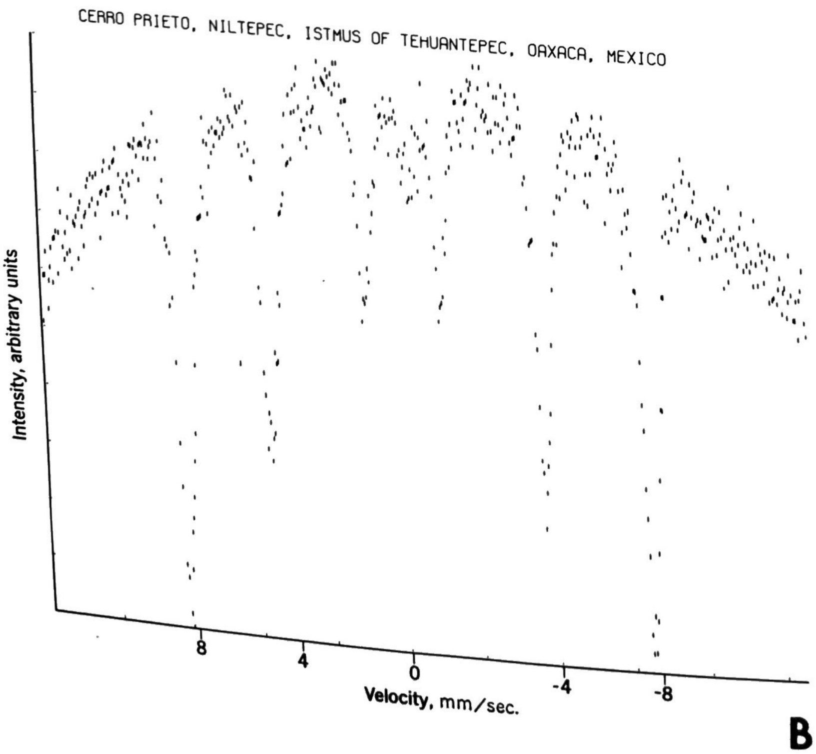


Figure 10.14 Mössbauer spectra of iron ore from source areas. (A) Ilmenomagnetite from Loma Salinas, Valley of Oaxaca. Mirrors of this ore (Group IV-B) were traded as far as San Lorenzo, Veracruz. (B) Hematite from Cerro Prieto, near Tehuantepec. This is the probable source for the Group II-A mirrors used at San Lorenzo and La Venta.

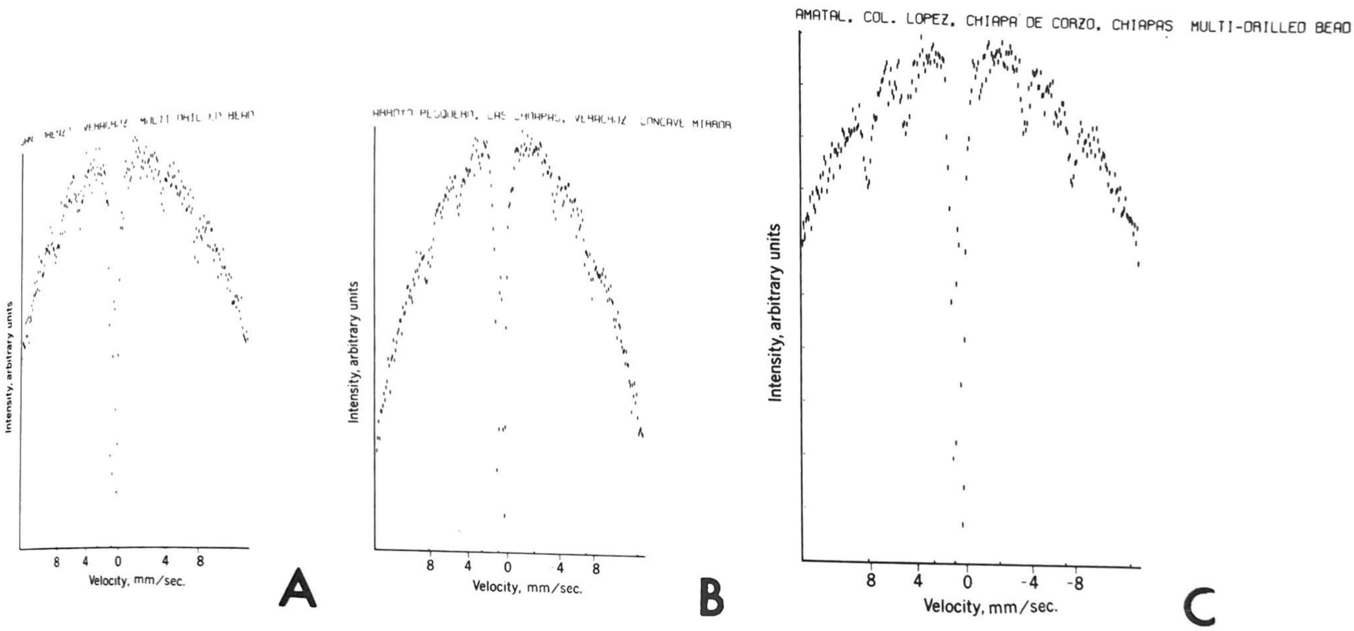


Figure 10.15 Mössbauer spectra of ilmenite artifacts from Group III-A. (A) Multidrilled bead from San Lorenzo, Veracruz; (B) concave mirror from Arroyo Pesquero, Veracruz; (C) multidrilled bead from Amatal, Chiapas. The source for Group III-A ilmenite has not yet been located.

Group III-A is an ilmenite whose geological source is as yet undiscovered, although it was widely used. Two small flat mirrors and one small concave mirror from San Lorenzo were made of this ilmenite. Two large mirrors from La Venta and a third from Arroyo Pesquero near Las Choapas, Veracruz, probably all date to the Middle Formative. Finally, this source was used for two unusual, multidrilled ilmenite beads, one from an Early Formative cache associated with a colossal head (Monument 17) at San Lorenzo, and another from an undated cache at Amatal near Chiapa de Corzo, Chiapas (Figure 10.15).

Group IV-A is a mixed magnetite-ilmenite of low quality, probably from a source at Loma del Arroyo Terrero near Arrazola, just off the western slope of Monte Albán in the Valley of Oaxaca. Lumps of this ore were carried to San José Mogote, but apparently not converted into mirrors; a single lump also occurred at Tierras Largas, only 8 km from the source.

Group IV-B is a mixed magnetite-ilmenite whose spectrum matches the source exposed on the surface and in arroyo profiles at Loma Salinas near San Lorenzo Cacaotepec, only 7 km southwest of San José Mogote, Oaxaca. The group includes a partly worked ore lump from San José Mogote and two small flat mirrors evidently traded to San Lorenzo, Veracruz, during the Nacaste phase (Figure 10.14).

The Early Formative: Magnetite Mirrors as an Item for Elite Exchange

By far the majority of the Early Formative archeological samples were either magnetites or mixed magnetite-ilmenites from sources in the Valley of Oaxaca. The bulk of the samples examined came from San José Mogote, the largest site in the Valley of Oaxaca during this period. A surface survey of the site revealed a striking, 1-ha concentration of iron ores—more than 500 pieces which had evidently been collected from various iron sources in the valley. Excavations within this area (Area A) exposed a series of four superimposed household clusters (numbered C1 through C4) and associated midden deposits. Whole and broken magnetite mirrors, unfinished mirrors, and worked and unworked lumps of iron ore were found together in these household clusters. Comparative examination of the finished and unfinished mirrors reveals a similarity in size, shape, and grinding technique. The typical products are thumbnail-size, flat-surface mirrors of various geometric forms, highly polished on one or both sides. Traces of multidirectional grinding are discernible on the unfinished and roughly finished sides of the mirrors. Closer examination of the mirror surfaces reveals some traces of ochre in surface irregularities, indicating that this substance may have been used to obtain the high polish of the finished products. It is not known for what the mirrors served, but evidence from figurines at Tlatilco and La Venta suggests they were worn on the chest, possibly by individuals of some special status. Some of the Oaxaca mirrors may have been worn as inlays in ornaments of pearl oyster shell, judging by some broken specimens found at Area A of San José Mogote (Figure 2.14h).

Considering the restricted distribution of the San José Mogote mirrors both within that site and within the valley, and their possible association with individuals of some social rank, it was proposed by Flannery (1968) that the mirrors were part of an elite exchange that linked Oaxaca with San Lorenzo and the Gulf Coast, as well as to other regions of Mexico. This proposal is supported by two mirrors of Oaxaca ore which reached San Lorenzo during the Nacaste phase, although the mechanisms of the exchange are unknown. We also have been able to demonstrate that mirrors or lumps of Oaxaca ores were traded toward the northwest, possibly as a form of exchange between elites. One lump of high-quality Oaxaca ore was found at the site of San Pablo, Morelos, 320 km northwest of San José Mogote. The possible links between these two sites in the exchange of Barranca de los Estetes obsidian blades are discussed earlier in this chapter. A finished mirror of Oaxaca ore with a presumed Early Formative date came from what appears to be an eroded public building at the site of Etlatongo in the Valley of Nochixtlán, some 50 km north of San José Mogote. Thus, although the limits of Oaxacan iron ore distribution cannot be defined on the basis of present evidence, they apparently exceeded 300 km to the northwest and 200 km to the northeast.

All of the small iron-ore mirrors recovered *in situ* in Oaxaca date to the second half of the San José phase, or roughly 1000–850 B.C. Many ore lumps, however, occurred in early San José phase context (1150–1000 B.C.), suggesting that earlier mirrors will eventually be found. All the flat mirrors recovered at San Lorenzo, including the two from a source in the Valley of Oaxaca, date to the Nacaste phase (900–750 B.C.). A single concave mirror at San Lorenzo appeared in pyramid fill with mixed sherds of the San Lorenzo A and B phases, and thus cannot with certainty be dated as earlier than San Lorenzo B (1000–900 B.C.). It therefore seems reasonable to assume that the major period for exchanges of small flat mirrors was roughly 1000–800 B.C.

The Middle Formative: Localized Mirror Production on the Gulf Coast

Sometime prior to 800 B.C., mirror production seems to have come to an end in the Valley of Oaxaca. Extensive excavation of Middle Formative (Guadalupe and Rosario phase) levels at the sites of Huitzo, San José Mogote, Fábrica San José, and Tierras Largas have failed to recover even one lump of ore. This same time period saw the defacement of monuments at San Lorenzo and the concomitant rise of La Venta. The small, flat magnetite mirrors disappeared from the archeological inventory of the Gulf Coast, and were replaced by large concave mirrors, which are most frequently made of ilmenite and hematite. These large mirrors often occurred in caches or offerings, in evident ceremonial context.

Evidence of Middle Formative iron-ore mirror production and exchange is incomplete, but the restricted Gulf Coast distribution of large concave mirrors suggests that they are a local product. Both the change in ore and the form of the mirrors reflect a localized development, distinct from the Early Formative iron ore exchange which extended over hundreds of kilometers and spanned many different culture areas.

Summary and Conclusions

It was argued at the start of this chapter that the varieties of Formative exchange were such that one model will not explain them all: Each commodity must be studied in its own right. Obsidian, a commodity to which all villagers had access, was originally moved by long-distance reciprocal trade in which quantity was partly a function of distance from source. With the advent of trade in prismatic blades, distribution of obsidian apparently took the form of "pooling" by some central agency before dispersal. Pacific Coast marine shell traveled to part-time craftsmen at certain villages, where it was converted into ornaments for local distribution. Magnetite was converted into small mirrors by one localized residential ward at a regional ceremonial–civic center and was traded to a limited number of distant regional centers, probably as a form of elite exchange. Other commodities on the move included Xochiltepec White pottery (probably of Gulf Coast manufacture) and Delfina Fine Gray pottery (of Oaxacan manufacture).

During the Early Formative, utilitarian goods and ceremonial items may both have circulated in the same "sphere of conveyance" (see discussion on p. 290). Consider, for example, the network of villages through which obsidian from Guadalupe Victoria, Puebla, was moved. Other products that may have circulated in the Guadalupe Victoria network were Xochiltepec White ceramics, turtle shell drums, pearly freshwater mussels, stingray spines, shark teeth, and conch shell trumpets, many of which probably reached Oaxaca from the Gulf Coast. Oaxaca in turn may have passed some of these on to the central highlands through the Barranca de los Estetes network. In this latter network, Delfina Fine Gray ceramics probably also circulated, since they reached Tlapacoya in the Valley of Mexico (Weaver 1967:29–30; Flannery *et al*. 1970:55). This Oaxacan pottery also reached Aquiles Serdán on the Chiapas Coast (unpublished data), perhaps by indirect linkage with the El Chayal exchange network. Other Pacific Coast items that may have accompanied the El Chayal obsidian to Oaxaca include pearl oyster, *Spondylus*, and other shell (see Figure 10.16).

During the Middle Formative, there were breakdowns and realignments of these networks. The number of shell species traded declined, and obsidian sources changed in value as prismatic blades became more important and local pooling or redistribution more common. Production of small, flat magnetite mirrors ceased, while the Gulf Coast went on to develop local production of large concave mirrors of ilmenite or hematite. The regionalization that set in was accompanied by great political evolution, reflected in elite residences and public buildings as well as increasing pooling or redistribution of goods. Following Rappaport's model, discussed earlier in the chapter, we might propose that the chiefdoms or incipient states of the Middle Formative had greater power to "demand production and enforce deliveries," signaling the end of an era in which circulation of ritual items was needed to sustain and regulate long-distance trade. Exchange continued, but with its character altered in response to the new sociopolitical systems of the later Formative.