Early Khmer sculptures of divinities in the round were typically carved from stone material whose aesthetic attributes, such as color, texture, and capacity to attain a polish, were favored at least until the ninth century. Moreover, from the sixth to the ninth century, except for rare exceptions, the stone selected to represent gods was consistently different from that used for architectural and decorative elements, such as cladding slabs and steles. Technical observations also show that stonework continued to be different during the Angkorian period, from the ninth to the fifteenth century—a distinction that supports the idea that this could have been a deliberate choice. Although it would be easy to interpret these differences solely on the basis of geographical circumstances, that approach may be too simplistic, especially in the complex case of pre-Angkorian sculpture production.

At first glance, the number and typologies of stone materials used by the Khmers, compared to other ancient cultures, seem relatively straightforward. Khmer sculptures in the round were made almost exclusively of sedimentary rock, mainly sandstone, and sedimentary rock predominates in architectural production as well. However, a close analysis reveals a wide variety of sandstones, sometimes subtly differentiated, which may reflect geographical, political, cultural, artistic, and technical factors, possibly evolving over time.

Sandstone is composed of an assemblage of mineral grains originating from the disaggregation of preexisting rocks whose fragments were transported, deposited, compacted, and cemented through geological processes. Widely represented and exposed in present-day Cambodia, Thailand, Vietnam, and Laos, sandstone has been used for temples and sculptures since pre-Angkorian times. Analytical methodologies can help determine geological and geographical origins, usage by early Khmer artisans, and patterns of trade of stone materials in Southeast Asia. Among the available techniques is petrographic analysis, the study of the mineral content and texture of rocks through microscopic examination of thin sections. It has been used by scientists to characterize, for conservation and provenance purposes, architectural stone employed in Angkor and more generally in the Khmer Empire. Similarly, petrographic studies of Khmer sculptures of divinities include surveys of pre-Angkorian to post-Angkorian works as well as analysis of productions more restricted in time and space.

According to the limited petrographic data on pre-Angkorian sculptures in the round, mostly collected from well-provenanced works in the National Museum of Cambodia, Phnom Penh, and the Musée Guimet, Paris, the majority of these sculptures were produced from compositionally and texturally immature sandstones of similar characteristics. Macroscopically, these sandstones appear compact and dark in color, ranging from gray to green. Some clearly exhibit poorly sorted texture, being flecked with visible angular black grains and tabular white grains. Many surfaces bear traces of a highly polished finish. While these sandstones have similar characteristics, detailed examination reveals slight variations that suggest a complex scenario in which various geological and geographical sources coexisted for the selection of stone material for sculpting the pre-Angkorian gods.

The geological origins and quarry locations of the stone used for pre-Angkorian sculptures remain speculative, largely because detailed geological mapping and petrographic studies are still lacking. Available data, most collected during early field research in Cambodia (third quarter of 20th century), point to a vast, heterogeneous, and poorly studied Triassic sedimentary sequence as the possible source of the favored sandstone types. Triassic sandstone and shale are exposed in several provinces in central, eastern, and southern Cambodia, such as Kampong Cham, Kratie, Kampong Thom, and Mondolkiri, and they are scattered in isolated outcrops in Kampong Speu and Takeo provinces, also in the south. Triassic sedimentary rocks are present in northern Cambodia as well and they extend into Thailand. To date, petrographic analysis of Triassic sandstones exposed in Kampong Speu and Takeo appears to exclude these provinces as sources for pre-Angkorian sculptures of divinities. Altogether, the existing data indicate that the Triassic sedimentary sequence overall is heterogeneous and that it includes numerous types of sandstone varying in their composition, texture, and diagenetic history.

While the Triassic sandstone formations are the most likely source of pre-Angkorian sculptural material, other possibilities, such as Devonian sedimentary formations in southern Cambodia and Vietnam, are being investigated. On the other hand, the provenance of sandstone used for architectural elements is better understood, having been identified as sedimentary formations of the Jurassic and Cretaceous periods.

Current research aims to characterize the stone used in pre-Angkorian and Angkorian sculptures in museums and archaeological excavations as well as that found in natural outcrops and possible quarries. The research, when supported by archaeological and art-historical findings, will significantly enhance our knowledge of stone sculpture traditions during this early period of Khmer history.

For this exhibition and publication, petrographic analysis was performed on samples collected from twelve sculptures in cooperation with the National Museum of Cambodia, and the National Museum of Vietnamese History, Ho Chi Minh City. The sandstones of two objects have been chosen to represent the two main traditions of pre-Angkorian sandstone carving: a standing Visnu, a sculpture in the round that would have occupied the central position in a pre-Angkorian shrine; and a lintel, an architectural element typically located above a temple's entryway.

Appendices

Stone Types and Sculptural Practices in Pre-Angkorian Southeast Asia

Federico Carò and Janet G. Douglas

Opposite: Devi, probably Uma (detail of cat. 94)
Standing Visnu

The late fifth- or early sixth-century representation of Visnu (cat. 57) from Tuol Koh, Takeo province, southern Cambodia, is made of sandstone with a composition and texture very similar to that of other pre-Angkorian sculptures in the present publication that have been studied, such as a seated Buddha from Angkor Borei (cat. 43). It is composed primarily of fine-grained (average grain size 0.18 mm), poorly sorted grains of quartz, feldspar, and lithic fragments varying in shape from subrounded to angular (fig. 148A).

About 30% of the grains are quartz, in both monocrystalline and subordinate polycrystalline varieties. Feldspar grains—about 36% of the framework—are primarily plagioclase and rare alkali feldspar; they are mostly weathered and often replaced by calcite. Lithic fragments (34%) are mainly volcanic rock and subordinate metamorphic and fine-grained sedimentary rocks. In this sample, volcanic lithic fragments show characteristic microlithic texture, with feldspars and opaque minerals dispersed in a vitreous groundmass. Often such fragments of volcanic rocks are altered, and the groundmass is devitrified and replaced by chlorite. Accessory minerals are abundant epidote, apatite, clinopyroxene, titanite, rutile, ilmenite, zircon, and iron oxides. Secondary calcite, replacing other grains and filling the pore spaces, is particularly abundant in this sandstone (fig. 148B); the presence of other authigenic minerals, such as chlorite, epidote, and sericite, suggests a minor degree of incipient metamorphism.

Most of the other stone samples from sculptural deities share a similar petrography and diagenetic history, which places them among compact, immature sandstones rich in volcanic lithic fragments and most likely belonging to the Triassic sandstone formations of Cambodia. However, within this group, variation in composition and texture can be noticeable, as in the stone of the standing Buddha from Tuol Ta Hoy (cat. 50), which is very fine grained (average grain size 0.13 mm) and particularly poor in lithic fragments (12%) when compared to the average composition of the studied sculptures.

Only two sculptures studied to date, a Śiva (cat. 96) and a representation of Śiva’s footprints (śivapāda; cat. 83), both from northern Cambodia, were made with sandstone from the same Jurassic formation, which was exploited intensively for building purposes during the Angkor period.

Lintel with a King’s Consecration

The lintel showing a king’s consecration (cat. 88), from Kampong Svay district, Kampong Thom province, central Cambodia, is dated to the mid-seventh century. The stone is a typical example of the Upper Jurassic–Cretaceous quartz-rich sandstone used for decorated lintels and ornamental elements in pre-Angkorian brick temples as well as later Angkorian monuments. The light brown quartz arenite has well-sorted fine grains (average grain size 0.21 mm; fig. 149A), the majority (about 85%) of which are quartz, with subordinate feldspar (5%) and lithic fragments (10%). The grains, which range from subrounded to subangular, are cemented by abundant authigenic quartz and kaolinite (fig. 149B). A thin layer of reddish iron oxides and hydroxides often coats the grains. The few lithic fragments are composed of aphanitic volcanic rock, low-grade metamorphic rock, and argillaceous mudstone, often deformed and squeezed between other grains to produce a fine-grained matrix. The scarce accessory minerals include epidote, apatite, zircon, ilmenite, rutile, and iron oxides. A similar light brown quartz arenite, although poorer in lithic fragments, was used for the lintel in the style of Sambor Prei Kuk in the Metropolitan Museum’s collection (cat. 18).

Fig. 148a: Thin-section micrograph of sandstone from standing Visnu (cat. 57). Note heterogeneity of composition and size of constituent grains. 148b: Detail of sandstone from standing Visnu showing abundant calcite (cc) replacing feldspar grains and filling pore spaces. Images were taken with a petrographic microscope with crossed polars.

Fig. 149a: Thin-section micrograph of sandstone from lintel with a king’s consecration (cat. 88). The grains are well sorted and mostly constituted of quartz. 149b: Detail of sandstone from the same lintel showing quartz (qz) grains cemented by authigenic quartz (arrows) and kaolinite (k). Images were taken with a petrographic microscope with crossed polars.
literature. For a detailed discussion of these objects, see Pirya Kairikth 1974b; Murphy 2010. For an overview of their distribution throughout northeastern Thailand and central Laos, see Murphy 2013. For examples from early Cambodia, see Boulbet and Dagens 1973. 3. Phoarpa Laosirinat and Suthilak Chaisot 1974, p. 383. See also Woodward 2003, pp. 108–12, pl. 27. 

4. For a fuller discussion of this phenomenon in northeastern Thailand, see Murphy forthcoming.


6. Klemmica Wanguak 2000, pp. 42–43. 7. Ibid., p. 45, defines this as a vihar; however, because of the presence of soma stones, I argue that it is, in fact, an abhors; see Murphy forthcoming.

V. SAVIOR CULTS

THE TRANSFORMATION OF BRAHMANICAL AND BUDDHIST IMAGERY IN CENTRAL THAILAND, 600–800

1. In katasamudra, the index finger and thumb form a ring shape, and the other three fingers fold downward. This hand gesture is also known in Sanskrit as abhayasamudra or abhayamudra. 2. Because this region was badly affected by malaria, high officials from Bangkok avoided travel to Phetbhub. As minister of the interior, Prince Damrong Rajanubhab was curious about the region and visited it on February 4, returning to Bangkok on February 25, 1904. 3. For more information on Si Thep, see Fine Arts Department 2007b.

4. No report of this excavation has been published. The archaeological mound was looted in the late 1960s, and it is believed that a large stone Buddha now in the Norton Simon Museum, Pasadena, came from this area.


9. Damrong Rajanubhab 1974, pp. 145–73. This Sārya is the only image that seems to be in high relief rather than fully in the round. This feature may indicate that it was attached to or placed on a wall or niche in the original structure. 10. During excavations at Si Thep in January 2013, a recovered fragmentary stone image of a male torso, h. 31½ inches (80 cm), was identified by the Fine Arts Department, Thailand, as Vamsu. Bangkok Post, March 30, 2013. 


37. Skilling 2009, p. 111. 38. Woodward 2003, pp. 105–6. 39. Khao Thomarat differs from other Dvāravat caves in central Thailand, such as Khao Ngo, Ratchaburi province, and Tham Phra Phothisath, Saraburi province, where the main Buddha images are portrayed in a pendant-logged position with hands in the teaching gesture. 40. Pattaratorn Chirapravati 2012.