

# A SOURCING STUDY OF TAIWAN STONE ADZES

Hsiao-Chun HUNG

Department of Archaeology and Natural History, The Australian National University, Canberra, Australia

## ABSTRACT

*Stone adzes are one of the most widespread and enduring artefacts in human prehistory, especially in southern China, Southeast Asia, the Pacific Islands and Taiwan. As Bellwood (1979:171) points out, apart from potsherds, the stone adze is the most obvious feature of museum collections of the Southeast Asian Neolithic. Certainly, the stone adze is a common artefact in Taiwan archaeology. By classifying the raw materials used in the manufacture of stone adzes and tracing their sources and distributions, this paper gives a better understanding of the cultural interactions that took place in Taiwan during the Neolithic. In this paper, more than 1000 stone adzes from 210 Neolithic sites are analyzed. These include sites on the island of Taiwan as well as on the surrounding islands in the Penghu Archipelago to the west, Xiaoliuqiu to the southwest, and Ludao and Lanyu to the southeast (Figure 1).<sup>1</sup>*

Taiwan prehistory is divided by Taiwan archaeologists into three major periods; Palaeolithic, Neolithic and Iron Age. Table 1 shows the three main phases of development during the Neolithic in Taiwan, between 5500 and 2000 cal. BP. Different types of adzes are represented in these phases.

## THE EARLY DABENKENG NEOLITHIC

After the Changbinian Palaeolithic, pottery first appeared in Taiwan at the start of the Dabengkeng Culture, dated between 5500 and 4500 cal. BP. Dabengkeng pottery jars and bowls are characterized by thick cord marked and painted decoration. According to Tsang (2000:58),

... sites with a similar artifact assemblage have been found in many places in Taiwan, including along the northern, eastern and south-western coasts, in the Taipei Basin and on the Penghu Islands.

Although only a limited number of adzes belong to the Dabengkeng Culture, it marks the first appearance of stone

adzes in the Taiwanese archaeological record. To date, a few grey slate and green nephrite adzes have been excavated from the Dabengkeng site at Bali in Taipei (see Chang 1969:194), and part of an andesite adze was found in the Zhuangcu site at Danshui in Taipei County (Liu 1997a:26). Several basalt adzes of this phase have been discovered at Guoye in the Penghu Islands (Tsang 1992). Basalt adzes were also found at Bajiacun (Huang 1974), and at Nanganli and Nanganlidong (Tsang 2003) in Tainan. These belong to a late phase of the Dabengkeng Culture.

## THE MIDDLE NEOLITHIC

During the Middle Neolithic, the Dabengkeng Culture was replaced by regional cultures distinguished by their fine cord-marked pottery, which replaced the thick cord-marked pottery of the Early Neolithic. Four of these regional cultures are Xuntangpu in the north, Niumatou in the west, Niuchouzi in the south, and Fushan in the east. While fine

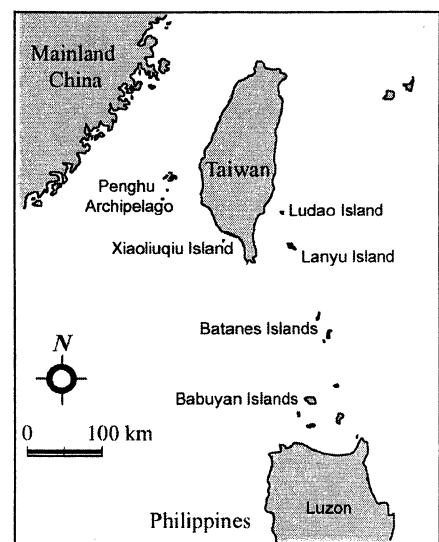


Figure 1: Map of Taiwan and surrounding islands.

HUNG: A SOURCING STUDY OF TAIWAN STONE ADZES

Table 1: Chronology of the Taiwan Neolithic

Phase	Date	Pottery / Culture	Regions
Early Neolithic	5,500-4,500 BP	Thick cord-marked pottery Dabengkeng culture 大盆坑文化	along the coast
Middle Neolithic	4,500-3,500 BP	Fine cord-marked pottery Xuntangpu Culture 訊塘埔文化 Niumatou Culture 牛罵頭文化 Niuchouzi Culture 牛稠子文化 Fushan Culture 富山文化	north central- west south east
Late Neolithic	3,500-2,000 BP	Plain pottery (occasionally with decoration) Yuanshan Culture 圓山文化 Zhishanyan Culture 芝山岩文化 Yingpu Culture 營埔文化 Dahu Culture 大湖文化 Beinan Culture 卑南文化	north north central- west south east

cord-marking was the principal surface finish on jars and bowls, incised, impressed and painted designs also occurred. The stone implements from this period are mostly flaked and ground artefacts such as hoes, knives, rectangular-sectioned adzes, arrowheads, net sinkers and jade objects. There are indications that these people were also agriculturists (Tsang 2000:67). Stone adzes became fairly universal in Taiwan sites.

During the Middle Neolithic, nephrite and basalt were used for adzes. Most of the nephrite adzes examined are either translucent green or weathered white. Almost all were manufactured by sawing and polishing technology to produce quadrangular forms with rectangular cross-sections (Figure 2a). During this period of fine cord-marked pottery, nephrite adzes were widely distributed throughout Taiwan and the nearby islands. For example, they occur on the east coast in Xiaoma Cave 10, Donghe-I (Huang and Chen 1990), Yanlio, Fushan and Shanyuan; at the southern tip in Eluanbi-II (Li 1983), Kending (Li 1985), Fengbitou (Chang 1969) and Youxianfang (Tsang 2003); in the central west at Caoton-Pinglin-IV (Tsang 1994), Lincuo (Liu 1997b:108), Niupu, Dingjie, Longquancun, Huilaili (Ho 2004:86) and Qijiawan (Liu and Yang 1997:80); on the northern coast at Guizishan (Liu 1990, 1997a; Tsang *et al.* 1990) and Wanlijiatou (Liu 1997a:26) and in the Penghu Archipelago at Suogang, Nangang-B and Liyushan-A (Tsang 1992). Most of these sites are coastal (Figure 3).

The basalt adzes are grey in color with brown surface spots, usually of weathered raw material. Almost all were manufactured by flaking and polishing into quadrangular forms with rectangular cross-sections (Figure 2c, d). Most

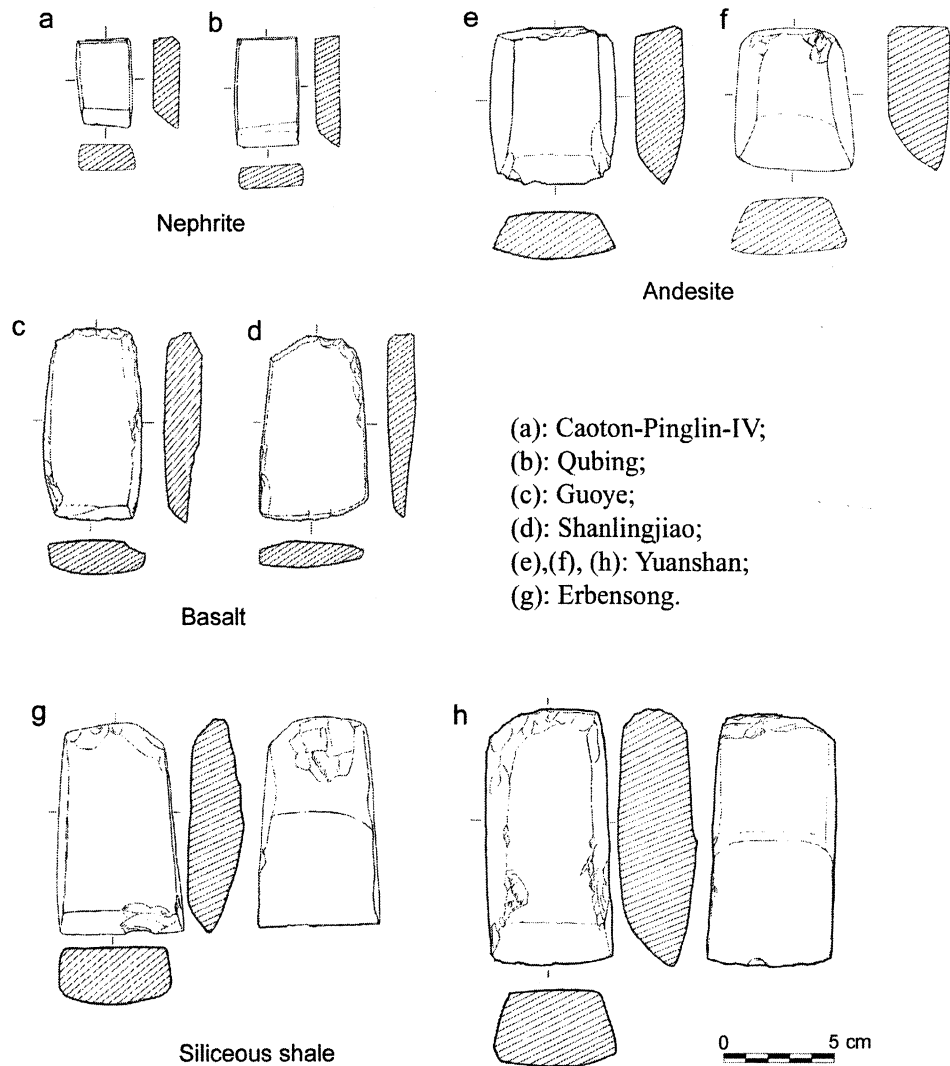
have been discovered in Penghu and southwest Taiwan, in sites such as Shagang-A, Shanlingjiao, Liangwengang-C and Suogang in Penghu (Tsang 1992); in Wushantou, Nichouzi (Li 1992), Nanguanli, Youxianfang (Tsang 2003) and Tantou (Tsang *et al.* 1994) in southwestern Taiwan; and in Daliao (Liu, K.H. 1993) in Xiaoliuqi (Figure 4).

THE LATE NEOLITHIC

Around 3500 BP, several new archaeological cultures developed in Taiwan. These were Yuanshan and Zhishanyan in the north, Yingpu in the middle-west, Dahu in the south and Beinan in the east. Different from the Early and Middle Neolithic cultures, each of these late Neolithic cultures had its own characteristic pottery and lithic assemblages.

During this period, diverse materials were used for stone adzes, not just nephrite and basalt, but also andesite, siliceous shale, tuffaceous sandstone, siltstone, basaltic andesite, slate and other rocks. In terms of raw material, the following observations can be made.

1. Nephrite adzes were still extensively used in the late Neolithic, as at Beinan (Lien and Sung 1986), Taidong-Liyushan (Chen 1991:48), Laofanshe (Huang 1991), Doulan, Mazhuling, Taiyuan (Guo 1995), Zhangguang (Chao 1994) and Yanliao (Chen *et al.* 1995) on the east coast; also Eluanbi-II (Li 1983) and Pujiangshan (Liu 1985) in the south; Shuiwaku (Ho *et al.* 1997), Qubing (Chen 1994a), Damalin (Shi and Liu 1987), Dapingding, Dongjiao (Huang 1977), Qigu and Babao (Liu and Yang 1997) in the central-west; and Wanshan (Liu 1996), Dazhuwei (Liu, Y.C. 1993), Zhishanyan (Huang 1984), Yuanshan (Huang *et al.* 1999a, 1999b) and Guizishan



(a): Caoton-Pinglin-IV;  
 (b): Qubing;  
 (c): Guoye;  
 (d): Shanlingjiao;  
 (e),(f), (h): Yuanshan;  
 (g): Erbensong.

Figure 2: Typical adze forms of nephrite, andesite, basalt and siliceous shale.

- (Liu 1990) in the north (Figure 3). Their forms and cross-sections are the same as those of the nephrite adzes in the Middle Neolithic (Figure 2b).
2. Andesite adzes are always grey in color with black or charcoal-grey spots. All of the andesite adzes were manufactured by flaking and polishing into quadrangular forms with trapezoidal cross-sections (Figure 2e, f), some being stepped for hafting. Andesite adzes have mostly been discovered in northern Taiwan, as at Guizishan (Tsang *et al.* 1990; Liu 1990, 1997a), Wanlijiao (Liu 1997a:26), Xiaguiroushan-III (Liu 1997a), Zhishanyan (Huang 1984), Dazhi, Yuanshan (Sung 1955; Huang *et al.* 1999a, 1999b), Jiantan, Longxiakou, Dabengkeng (Chang 1969), Goutishan (Liu 1982), Guweishan (Lien and Sung 1992) and Tudigongshan (Chen 1994b) (Figure 5).
  3. Siliceous shale adzes are either black or reddish-brown with glossy surfaces. They were produced using exactly the same technology as the andesite adzes and have the same forms and cross-sections (Figure 2g, h). Siliceous shale adzes have been unearthed at most sites in northern Taiwan, such as Fuji (Liu 1997a), Guizishan (Tsang *et al.* 1990; Liu 1990, 1997a), Wanlijiao (Liu 1997a:26), Fulong Elementary School (Liu 1997a), Guandu, Zhishanyan (Huang 1984), Dazhi, Yuanshan (Sung 1955; Huang *et al.* 1999a, 1999b), Jiantan, Longxiakou, Dabengkeng (Chang 1969), Dayuanjianshan (Huang and Liu 1980; Lien and Sung 1992), Goutishan



(Liu 1982), Tudigongshan (Chen 1994b), Xiaotongluoquan, Erbensong (Liu and Wu 1995) and Xuejian (Figure 6).

4. Tuffaceous sandstone adzes are light green on the surface with blackish green stripes. Almost all of them were manufactured by flaking and polishing into trapezoid forms with oval cross-sections (Figure 7a, b). Tuffaceous sandstone adzes occur in central Taiwan in sites such as Niupu (Chao and Chung 1992), Futianli, Xincuozi, Jiushe (Ho 1977), Neilu (Huang 1977), Caoton-Pinglin-IV (Tsang 1994), Shuiwaku (Ho *et al.* 1997), Quping (Chen 1994a), Dongjiao, Daqiuyua, Dapingding (Huang 1977), Eliao, Tianliaoyuan (Tsang 1977), Suicheding (Luo 1977), Linnei Pingding, Meilin and Tsatasaya. Recently, some tuffaceous sandstone adzes were found in the Youxianfang site (Tsang 2003) in the Tainan area (Figure 8).
5. Siltstone adzes are smooth and light green in color. The majority were manufactured by sawing and polishing into quadrangular forms with rectangular cross-sections (Figure 7c, d). Most of the archaeological sites in central Taiwan, particularly in the central mountains, have produced siltstone adzes. These sites include Caoton-Pinglin-II, Caoton-Pinglin-IV (Tsang 1994), Dingkanzi

(Tsang 1984), Qigu, Neilu, Eliao, Dapingding, Dongjiao (Huang 1977), Toushe (Sun 1977), Damalin (Shi and Liu 1987), Shuiwaku (Ho *et al.* 1997, Dongpu zone I (Gao and Chau 1988), Yiskiona, Dabang, Chashan and Daibitsana (Tsang and Chang 1995a, b) (Figure 9).

6. Basaltic andesite adzes are green in color with blackish green stripes. Most all of this type were manufactured by flaking and polishing into quadrangular forms with rectangular cross-sections (Figure 7e, f, g). Since their surfaces are similar to the skins of Taiwanese watermelon they are called 'watermelon-adzes' by Taiwanese archaeologists. Basaltic andesite adzes are mostly found on the eastern coast and southern tip of Taiwan (Figure 10). They also occur on the islands of Ludao and Lanyu, as well as occasionally in Penghu. The main sites of

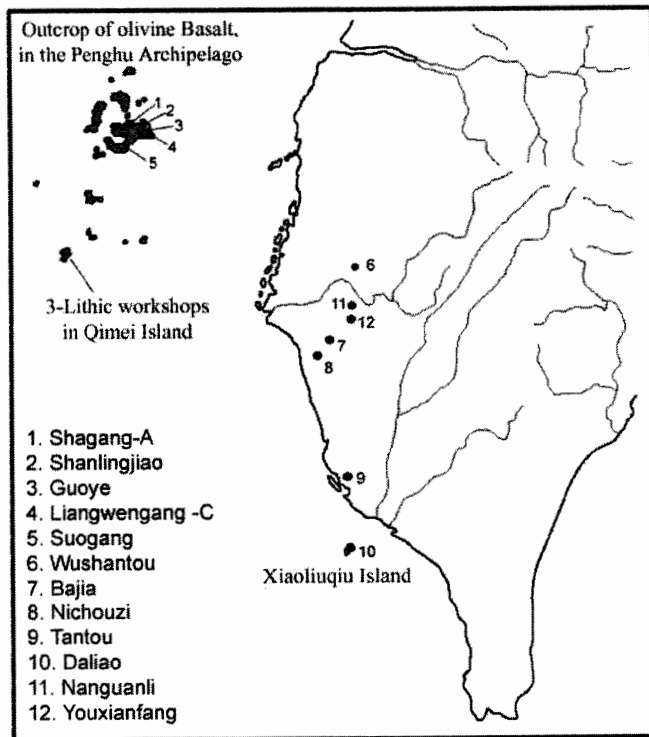


Figure 4: The distribution of olivine basalt adzes in the Penghu Archipelago and southwestern Taiwan.

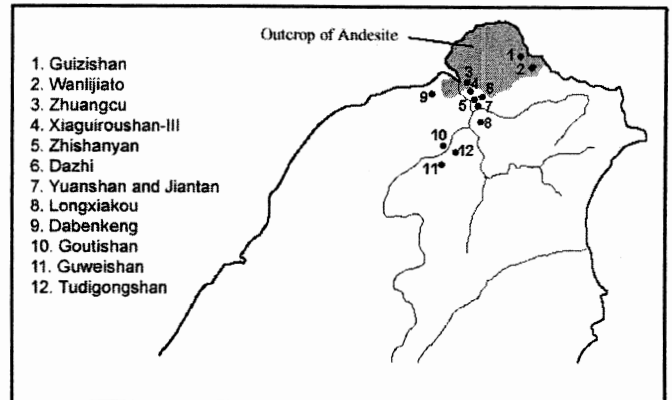


Figure 5: The distribution of andesite adzes in northern Taiwan.

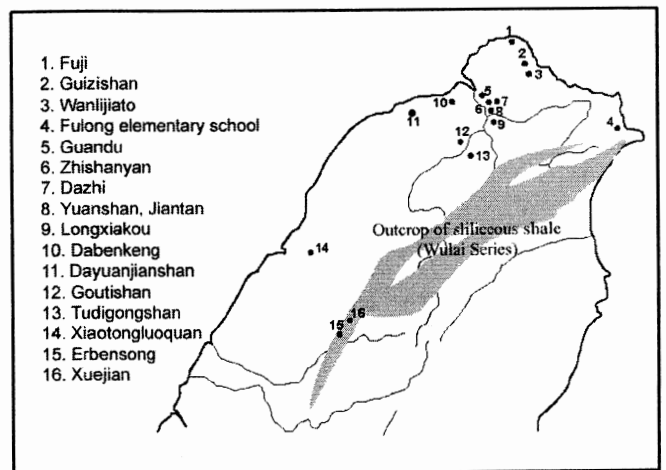


Figure 6: The distribution of siliceous shale adzes in northern Taiwan.

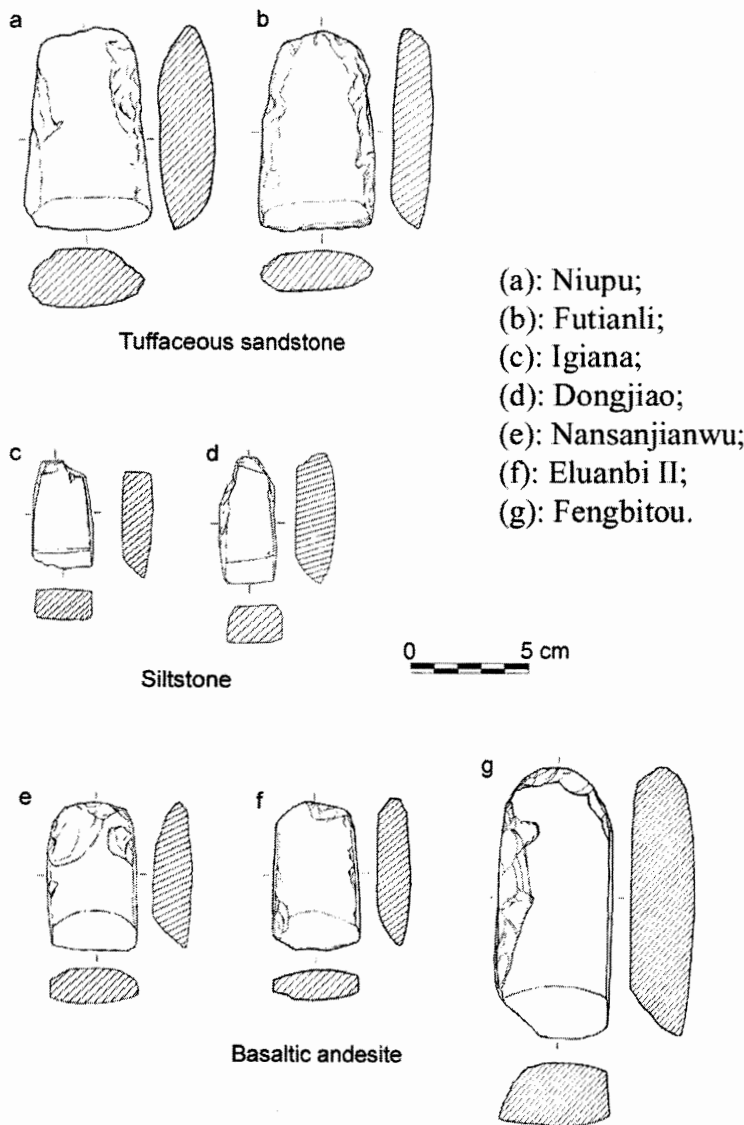


Figure 7: Typical adze forms of tuffaceous sandstone, siltstone and basaltic andesite.

discovery are Maogong, Shipaiqiao, Nansan-jianwu, Zhangguang (Chao 1994), Xiatianzu, Danman, Baishoulian, Heping, Taiyuan (Guo 1995), Mazhuling, Donghe I, Donghenan I, Doulan, Doulan II, Wuxian I (Lien and Sung 1992), Shitoushan, Laofanshe (Huang 1991), Beinan (Lien and Sung 1986), Taidong-Liyushan (Chen 1991:48), Daniao II, Dawu, Eluanbi I, Eluanbi II, Kending, Pujiangshan (Liu 1985), Beiye, Fengbitou (Chang 1969), Qing-shuiyan (Liu and Chen 1997), Tantou (Tsang *et al.* 1994), Chengqinghu, Shoushan, Xiajia,

Dahu, Hunei (Liu and Chen 1997), Niu-chouzi (Li 1992), Bankala I (Liu and Chen 1997), Xianshan (Tsang *et al.* 1994; Liu and Chen 1997), Shagang, Youzihu (Liu and Qiu 1995), and Yayu (Kano 1946).

7. Other rocks such as slate, shale and sandstone were used for adzes in Taiwan, but are fewer in number than those manufactured in the above materials.

In summary, therefore, during the middle Neolithic, *c.* 4500 to 3500 BP, nephrite was the most widespread adze stone in Taiwan, distributed throughout the entire island as well as on several surrounding islands. To date, more than 30 Middle Neolithic archaeological sites in Taiwan have produced nephrite adzes with fine cord-marked pottery. It is important to note that the most typical shape of nephrite adzes is sharply rectangular. Irrespective of age or culture, all nephrite adzes were manufactured using the sawing technique. Also during the Middle Neolithic, basalt adzes were widely used by people living in the Penghu Archipelago and southern and western Taiwan. Altogether, 12 sites have produced basalt adzes associated with fine cord-marked pottery.

During the Late Neolithic, between 3500 and 2500 BP, nephrite adzes continued to be the most widespread type in Taiwan, occurring at more than 70 sites. The nephrite adzes from the late Neolithic are no different, stylistically, from Middle Neolithic adzes. Apart from nephrite, five other rocks were used for adzes by different regional groups. These include igneous rocks such as andesite and basaltic andesite, metamorphic rocks such as siliceous shale and slate, and sedimentary rocks such as tuffaceous sandstone and siltstone. For the most part, andesite and siliceous shale adzes occur in sites of the Yuanshan and Zhishanyan cultures in

northern Taiwan, both distributed within radii of 30 km. In central Taiwan, tuffaceous sandstone and siltstone adzes are always found in Yingpu sites, mostly distributed within radii of 45 km. Basaltic andesite adzes are only found in sites belonging to the Beinan Culture of eastern Taiwan and the Dahu Culture of southern Taiwan, together with a few occurrences in Penghu.

#### SOURCES OF ADZE ROCKS

Of all of the materials used in the manufacture of adzes, nephrite is the rarest in geological terms. There are only 30 major deposits of nephrite in the world. In Asia, nephrite

deposits have been reported in Russia, China, Korea and Taiwan. In Taiwan, the main source is Fengtien, still serving as a nephrite mine today in Hualian, eastern Taiwan.

During the past decade, archaeologists and geologists in Taiwan have conducted several investigations into the sources of ancient nephrite. Lien Chao-Mei and her team have analyzed nephrite artifacts from Beinan using petrographic microscopy and chemical composition data. Their results suggested that Fengtien was the most probable source for the Beinan nephrite artifacts (see Wang *et al.* 1996; Tan *et al.* 1997; Lien 2002).

Since 1998, I have compared 34 nephrite artifacts from different sites in Taiwan and Penghu with raw materials from the Fengtien source. The samples have been studied by X-ray diffraction, oxygen isotope analysis, and electron microprobe analysis. The results show that all are similar to Fengtien nephrite. The same results were reported by Huang Shih-Chiang and Zhou Shu Rong (2001), who compared 10 nephrite artifacts from the Laofanshe site near Taidong with Fengtien nephrite. These results indicate that most of the nephrite artifacts found at Neolithic sites in Taiwan originated from the same source area in eastern Taiwan (Figure 3).

The sources of several other rock types used for adzes were also investigated.

**Basalt.** Geological surveys show that olivine basalt is quite rare on the island of Taiwan itself, but major outcrops of olivine basalt occur in the volcanic islands of the Penghu Archipelago. Since 1940, several archaeologists have addressed the question of the distribution of basalt adzes and axes in Taiwan (Kokubu 1940:112; Li 1992; Tsang 1992; Rolett *et al.* 2000). In 2000, three huge lithic workshops at Nangang, Donghu and Xibeiwan were discovered on Qimei Island by Barry Rolett from the University of Hawai'i and Tsang Cheng Hwa and this author from Academia Sinica in Taipei (Tsang and Hung 2001; Rolett *et al.* n.d.). They analyzed the raw materials and flakes from the lithic workshops on Qimei and compared them with basalt items from archaeological sites in Taiwan. Based on typology, mineralogy and major and trace element chemical compositions as analysed by X-ray fluorescence and ICP-MS, it has been concluded that the basalt adzes and axes were imported into Taiwan proper from Qimei between c. 4500 and 3500 BP (Rolett *et al.* n.d.) (Figure 4).

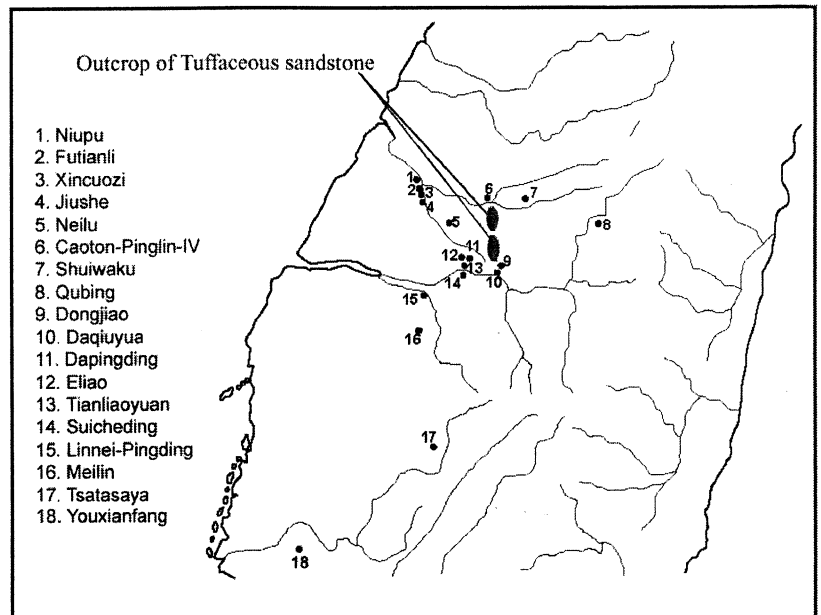


Figure 8: The distribution of tuffaceous sandstone adzes in central Taiwan.

**Andesite.** In Taiwan, the majority of andesitic volcanic rocks are located around the late Pliocene Datun, Guanyin and Jilong volcanoes of northern Taiwan, and in the Coastal Range of eastern Taiwan. Since the andesite adzes have the same mineral characteristics as the andesites from northern Taiwan, being composed of feldspar, pyroxenes, amphibole and biotite (Chen 1990:6), it can be concluded that the raw materials come from this region (Figure 5).

**Siliceous shale.** Siliceous shale adzes are quite common from the northern coast down to Miaoli County. According to geological research, deposits of siliceous shale are located in the Snow Mountain (Wulai Series) (Ichikawa 1929; Ho 1986:40) and Central Mountain Ranges. The major source for siliceous shale adzes appears to have been the Wulai Series (Figure 6).

**Tuffaceous sandstone.** More than 90% of existing tuffaceous sandstone adzes come from central Taiwan and the most likely source is the Tsukeng Formation in Nantou, in the western foothills in central Taiwan. The type locality for the Tsukeng Formation is located in the Zhongliao Hills in Nantou County (Ho 1986:81) (Figure 8).

**Siltstone.** The distribution of siltstone adzes overlaps in central Taiwan by about 80% with the distribution of tuffaceous sandstone adzes. The general opinion amongst Taiwan archaeologists is that the raw material was probably quarried from somewhere in the western foothills of central Taiwan. However, no siltstone outcrops have been discovered to date (Figure 9).

HUNG: A SOURCING STUDY OF TAIWAN STONE ADZES

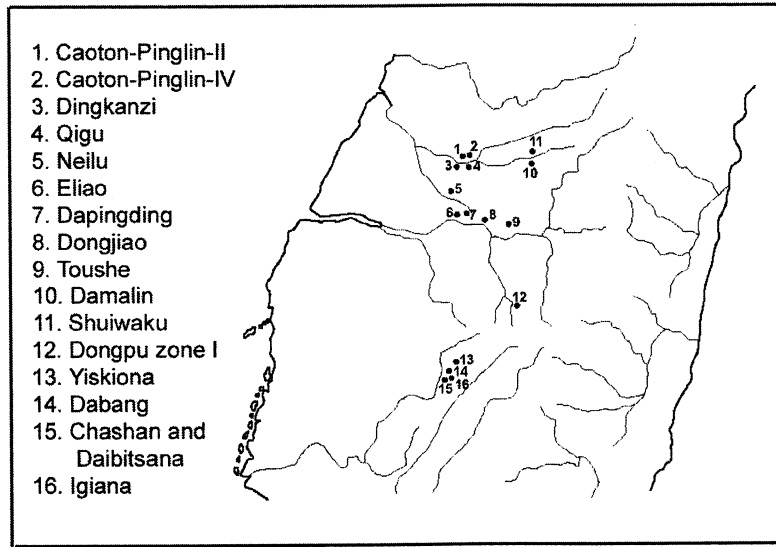


Figure 9: The distribution of siltstone adzes in central Taiwan.

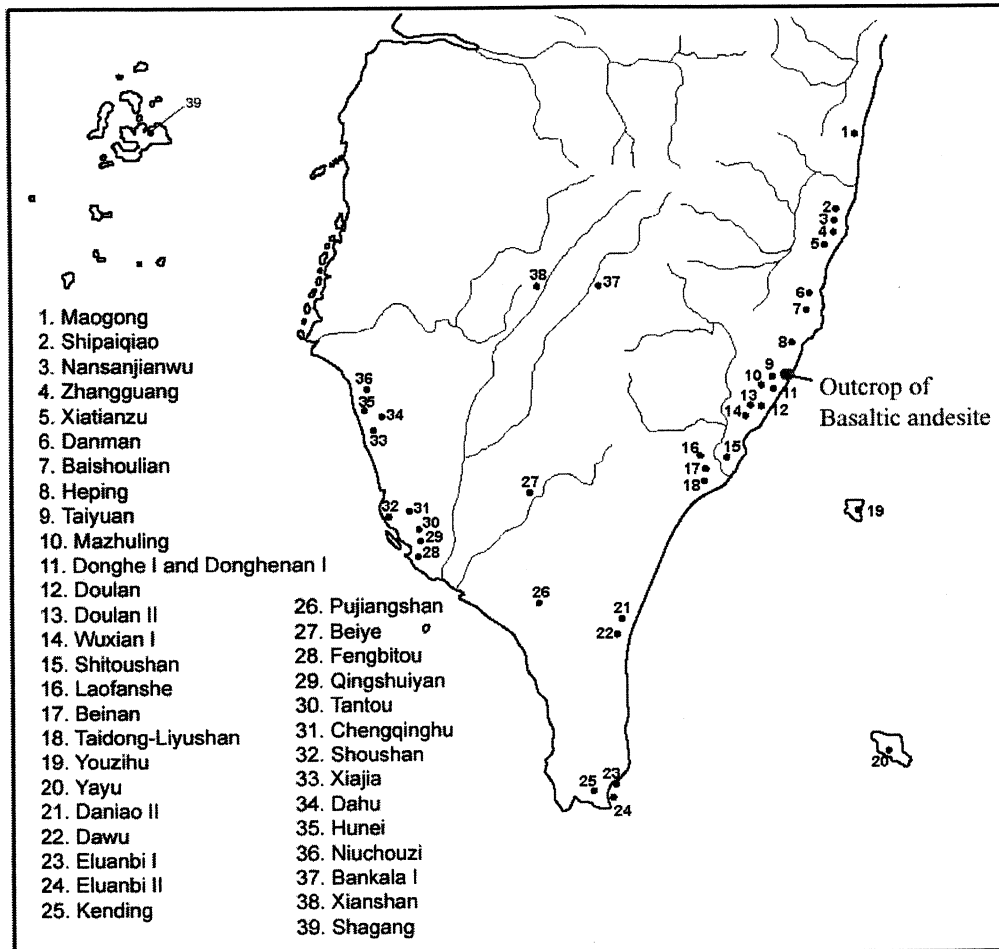


Figure 10: The distribution of basaltic andesite adzes in eastern and southern Taiwan.



*Basaltic andesite.* Basaltic andesite adzes have been found along the middle part of the eastern coast at Fengbin, and at sites along the southwest coast near Gaoxiong and Tainan. The colors and lines on the surfaces of basaltic andesite adzes are extremely distinctive. Rocks of this type only occur around the estuary of the Mawuku River and in the surrounding coastal area of Donghe in eastern Taiwan. Because the outcrops of basaltic andesite are most densely distributed in the Donghe area, north of Taidong, it is likely that this region served as the raw material source for these artefacts (Figure 10).

It is worth noting that the raw material sources for adzes changed over time in southwest Taiwan. The alluvial plains of this region are devoid of igneous rocks and all raw materials would have to be imported. So it is interesting that olivine basaltic adzes from Qimei Island dominated in the Niuchouzi Culture of the Middle Neolithic. These then disappeared rather suddenly at the beginning of the Dahu Culture, to be replaced by adzes manufactured from basaltic andesite from the east coast and tuffaceous sandstone from central Taiwan.

*Other sources.* There are also rare specimens made from unusual rocks that appear to be exotic to Taiwan. For instance, some adzes of metamorphic rock (e.g., green sandstone) found in eastern Taiwan are very similar in shape and raw material to stone adzes found in Batanes and northern Luzon (Figure 11a,b). Further research is required on this topic, but it appears that some stone adzes were carried to Taiwan from the Philippines during the prehistoric period (Figure 11c).

#### CRAFT SPECIALIZATION AND EXCHANGE

As well as sourcing the raw materials, 80% of the adzes analysed in this study were also measured for length, width, thickness, ratio of length/width, ratio of width/thickness, and bevel angle. The results reveal high levels of consistency. For example, the 265 basaltic andesite adzes from 12 sites were all similar in size, with bevel angles between 55.6° and 58°. The surfaces of the basaltic andesite adzes were mostly well polished, with many flake and pecking scars on the butts. These characteristics were absent in adzes of other raw materials and suggest a high degree of standardisation, consistent with some degree of craft specialization within each culture.

In general, most raw materials appear to have circulated within specific cultural regions without being traded over very large distances. Andesite and siliceous shale adzes occur mostly in the Yuanshan and Zhishanyan cultures. Tuffaceous sandstone and siltstone adzes are linked to the Yingpu Culture. These raw materials are mostly found within outer radii of only 45 km, and the find places of most adzes

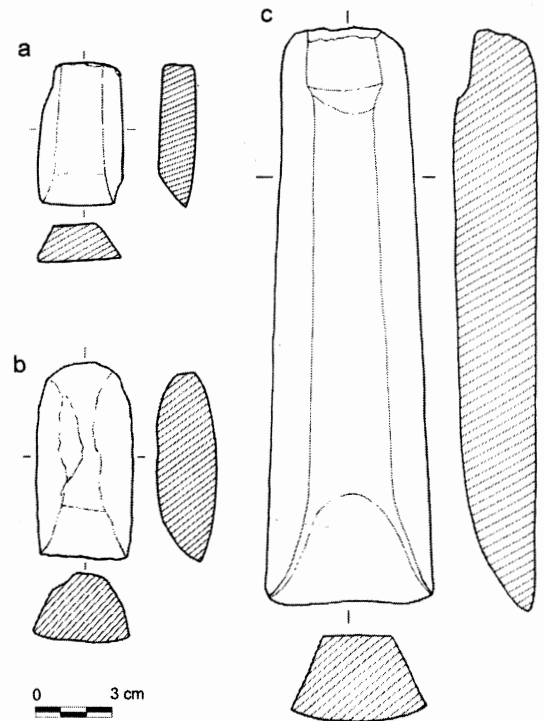


Figure 11: Unusual type/rock of stone adzes. (a): Danman, eastern Taiwan; (b): Sanjianwu, eastern Taiwan; (c): Imoruru, Lanyu Island (after Duff, 1970).

at sites close to rivers suggests that down-the-line trade followed riverine transport routes.

Although Penghu and southwestern Taiwan are divided by the Taiwan Strait, the similarities of the basaltic adzes and pottery between the two areas suggests they belonged to the same prehistoric culture, namely the Niuchouzi. In other words, the quarrying, manufacturing, exchange and use of these basalt adzes were all concentrated within a relatively uniform cultural background, both in Penghu and on Taiwan. However, since the lithic workshops on Qimei Island are very large, future research is needed to clarify this issue.

#### EXTERNAL TRADE

In contrast to the raw materials just discussed, adzes of nephrite and basaltic andesite<sup>2</sup> are distributed across the boundaries of regional cultures. Nephrite adzes have been found throughout Taiwan and were very popular in the Middle and Late Neolithic. Basaltic andesite adzes were also distributed in two separate cultural areas, belonging to the Beinan and Dahu cultures. Therefore, as well as within-group exchange, external exchange whereby goods are traded over much greater distances, moving from one social unit to another (see Renfrew and Bahn 1997:336) is indicated.

HUNG: A SOURCING STUDY OF TAIWAN STONE ADZES

Analysis of the assemblage of nephrite artefacts also suggests three stages of nephrite working for adze manufacturing. First of all, Fengtien was the nephrite source where primary quarrying occurred. The sites of Pinglin and Yanliao near Fengtien served as workshops for the first stage of nephrite adze manufacture, involving the shaping of blanks. The sites of Beinan, Qubing, Shuiwaku and Damalin then served as workshops for the final stages of manufacture (see Figure 3, locations 98, 34, 21, 22 respectively).

LONG-DISTANCE INTERACTIONS

There is also evidence for interaction between northern Taiwan (especially Yuanshan and Zhishanyan), mainland China and eastern Taiwan (especially Beinan) with the Batanes Islands and northern Luzon in the Philippines to the south. For example, the stepped adze with trapezoidal cross-section occurs in the Yuanshan and Zhishanyan cultures. However, this form does not occur in Taiwan prior to these cultures, suggesting that it was introduced secondarily by contact with the Neolithic cultures of the southeastern coast of mainland China, where such adzes are common. In addition, there is evidence for long distance trade or population movement between Taiwan and the northern Philippines at about 3500 BP, indicated by the presence of northern Luzon types of adzes in eastern Taiwan and by finds of artefacts of Taiwanese nephrite in the northern Philippines. Because the distance between Fengtien in eastern Taiwan and the Cagayan Valley of

northern Luzon is more than 600 km, long distance-interaction is indicated (Figure 12). Research is continuing on this situation of long distance nephrite transport to the Philippines.

NOTES

1. This paper uses pinyin place name romanisations. See Appendix 1 for Wade-Giles concordances.
2. Concerning the date and distribution of the basaltic andesite adzes, recent reports mention that such adzes have been excavated at Youxianfang in the southern plain (Tsang 2003) and at Fushan on the east coast (both are Middle Neolithic). In order to understand better the implied interactions between southern and eastern Taiwan, it will be necessary in future studies to confirm the earliest date for these adzes (Middle Neolithic or Late Neolithic?).

ACKNOWLEDGMENTS

I would like to thank to Tsang Cheng-Hwa, Lin Shu-Fen, Chao Ching-Yung, Chen Chung-Yu, Huang Shih-Chiang, Lien Chao-Mei, Sung Wen-Hsun, Chang Kwang-Chih, Ho Chuan-Kuen, Liu Yi-Chang, Li Kuang-Ti, Chen Kuang-Zu, Chen Yu-Mei, Qu Hui-Li, Liu Ker-Hong, Yang Sui-Ling, Lee De-Ren and Yang Feng-Ping, without whose generous support this research could not have been completed. My special thanks to Peter Bellwood, Judith Cameron and Doreen Bowdery who have encouraged and helped to correct the manuscript.

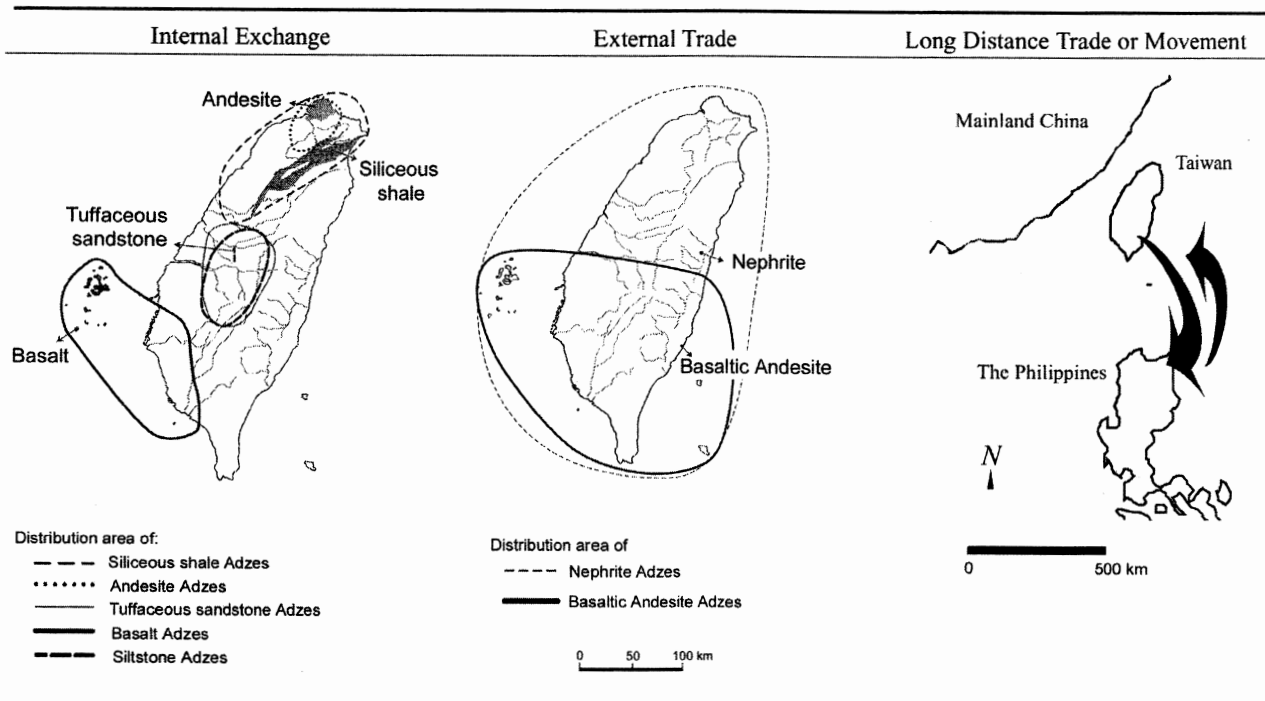


Figure 12: Exchange systems in Taiwan and the northern Philippines.

REFERENCES

- Bellwood, P. 1979. *Man's Conquest of the Pacific*. New York: Oxford University Press.
- Chang, K.-C. 1969. *Fengpitou, Tapenkeng and the Prehistory of Taiwan*. New Haven: Yale University, *Publication in Anthropology* 73.
- Chao, C.-Y. 1994. Tai Dong xian Zhang Bin xiang Zhang Guang yi zhi fa jue bao gao (Report on the archaeological excavation of the Zhangguang Site in Taidong). Master dissertation, National Taiwan University, Taipei (in Chinese).
- Chao, C.-Y. and Y.-H. Chung. 1992. Zhang Hua xian Zhang Hua shi Niu Pu yi zhi diao cha bao gao (Report on the archaeological investigation of the Niupu Site in Zhanghua County). *Field Archaeology* 3(2):49-66 (in Chinese).
- Chen, C.-Y. 1994a. *Qubing*. Taipei: Institute of History and Philology, Academia Sinica (in Chinese).
- Chen, C.-Y. 1994b. Tai Bei dou hui qu da zhong jie yun xi tong Tu Cheng yan shen xian wen hua yi zhi fa jue ji chu bu zhan shi gui hua qi mo bao gao (Report on the excavation and Exhibition of Tucheng Extension, Taipei MRT System). Unpublished Paper, Institute of History and Philology, Academia Sinica, Taipei (in Chinese).
- Chen, Y.-A. 1991. Tai Dong xian Li Yu Shan yi zhi de kao gu xue yan jiu (Archaeological study of the Liyushan Site in Taidong City). Master dissertation, National Taiwan University, Taipei (in Chinese).
- Chen, Y.-Y., K.-X. Li and M.-Z. Ye. 1995. Hua Lian xian Yan Liao yi zhi 1995 nian Qiang jiu fa jue bao gao (Report on the salvaged excavation of the Yanliao Site, 1995). Unpublished Report, National Museum of Prehistory, Taitung (in Chinese).
- Chen, Z.-H. 1990. *Tai Wan zhi Huochengyan (Plutons in Taiwan)*. Taipei: Central Geological Survey, MOEA (in Chinese).
- Duff, R. 1970. *Stone Adzes of Southeast Asia*. Canterbury: Canterbury Museum Bulletin No.3.
- Gao, Y.-D. and M.-Y. Qiu. 1988. *Dong Pu Di Yi Lin yi zhi Yu Shan guo jia gong yuan zao qi ren lei ju luo shi de kao gu xue yan jiu (The Dongpu Diyilin Site - Archaeological research for early settlement in the Yushan National Park)*. Taipei: Administrative Bureau of the Yushan National Park, Ministry of Interior Affairs (in Chinese).
- Guo, S.-Q. 1995. Ti Dong xian Ma Wu Ku xi Liu Yu shi qian yi zhi diao cha yu yan jiu (Archaeological investigation and research on the Mawuku Valley). Master dissertation, National Taiwan University, Taipei (in Chinese).
- Ho, C.-K. 1977. Tai Zhong xian Da Du shan taidi ji Zhang Hua Nan Tou xian jing Ba Gua shan Tai di shi qian wen hua diao cha bao gao (Report on archaeological investigation of the Dadu Terrace in Taizhong and Bagua Terrace). In K.C. Chang (ed.) *Tai Wan sheng Zhuo Shui xi yu Da Du xi liu yu kao gu diao cha bao gao (Archaeological investigations in the Zhuoshui and Dadu River Valleys of Taiwan)*, pp. 27-64. Taipei: Institute of History and Philology, Academia Sinica, *Special Publication No.70* (in Chinese).
- Ho, C.-K. 2004. *Tai Wan de shi qian wen hua (The prehistoric cultures of Taiwan)*. Taipei: Walkers Culture (in Chinese).
- Ho, C.-K., J.-W. Zheng and H.-W. Chen. 1997. *Shui wa ku yi zhi diao cha ji kao gu fa jue - bao gao (Report on archaeological investigation and excavation in the Shuiwaku Site)*. Taichung: National Museum of Natural Sciences (in Chinese).
- Ho, C.-S. 1986. *Tai Wan di zhi gai lun - Taiwan di zhi tu shuo ming shu (Introduction to Taiwan Geology - Manual of the Taiwan Geological Map)*. Taipei: Central Geological Survey, MOEA (in Chinese).
- Huang, S.-C. 1974. Tain Nan xian Gui Ren xiang Ba jia cun yi zhi diao cha (Archaeological investigation on the Bajiacun Site of Taiana County). *Bulletin of Archaeology and Anthropology* 35/36:62-8 (in Chinese).
- Huang, S.-C. 1977. Zhuo Shui xi bei an kao gu diao cha bao gao (Report on archaeological investigations on the northern bank of the middle Zhuoshu River Valley). In K.C. Chang (ed.), *Tai Wan sheng Zhuo Shui xi yu Da Duxi liu yu kao gu diao cha bao gao (Archaeological Investigations in the Zhuoshui and Dadu River Valleys of Taiwan)*, pp. 327-349. Taipei: Institute of History and Philology, Academia Sinica, *Special Publication No.70* (in Chinese).
- Huang, S.-C. 1984. *Zhi Shan Yan yi zhi fa jue bao gao (Report on the excavation of the Zhishanyan Site)*. Taipei: Tai Bei xian wen xian wei yuan hui (The Taipei Committee of Documents) (in Chinese).
- Huang, S.-C. 1991. *Tai Dong xian Tai An cun Lao Fan She yi zhi (The Laofanshe Site of Taian Village, Taidong)*. Taipei: Zheng Zhong Press, Archaeological and Historical Cultures (in Chinese).
- Huang, S.-C. and Y.B. Chen. 1990. *Dong He di qu yi zhi shi jue ji shi qian wen hua zhong jian (Archaeological excavations for reconstruction the prehistoric culture in Donghe)*. Taipei: Anthropology Department of National Taiwan University (in Chinese).
- Huang, S.-C. and Y.-C. Liu. 1980. *Quan sheng zhong yao shi ji kan cha yu zheng xiu jian yi - kao gu yi zhi yu jiu she bu fen (Investigations and suggestions on the reconstruction of the major archaeological sites of Taiwan Province)*. Taipei: Department of Anthropology, National Taiwan University (in Chinese).
- Huang, S.-C., Y.-C. Liu and F.-P. Yang. 1999a. Yuan Shan yi zhi zhu ti gong yuan Yuan Shan yi zhi kao gu diao cha yan jiu ij hua (Archaeological investigation of the Yuanshan Site in the Yuanshan Theme Park). Unpublished Monograph, Department of Anthropology, National Taiwan University, Taipei (in Chinese).
- Huang, S.-C., Y.-C. Liu and F.-P. Yang. 1999b. Yuan Shan yi zhi shi ji gon yuan - fan wei qu kao gu fa jue yan jiu ji hua (Archaeological investigation of the Yuanshan Site in the Yuanshan Relic Park). Unpublished Monograph, Department of Anthropology, National Taiwan University, Taipei (in Chinese).

HUNG: A SOURCING STUDY OF TAIWAN STONE ADZES

- Huang, S.-C. and S.-R. Zhou. 2001. Lao Fan She yi zhi bu fen chu tu yu qi cai zhi yu gong yi ji shu te zheng (Material and technological characters of the nephrite artifacts from Laofanshe Site). In X.H. Qian (ed.), *Conference Papers for the Ancient Jade Studies from Cross-Strait*, pp. 421-36. Department of Geology, National Taiwan University, Taipei (in Chinese).
- Ichikawa, Y. 1929. Tai Wan Baiden no Tishitu kenkyu (The stratigraphy study of coalfields in Taiwan). *Bulletin of Geology* 36:429 (in Japanese).
- Kano, T. 1946. *To Nan Asia Min Zoku Gaku Sen Shi Gaku Ken Kyu* (A Study of Southeast Asian Archaeology and Ethnology (original in Japanese). Tai Wan sheng wen xian wei yuan hui (The Documents Committee of Taiwan Province) (in Chinese) (translated by W.H. Sung in 1955). Taipei.
- Kokubu, N. 1940. Tai Wan nannbu ni Okeru Kanranseki Genbugan Wo Motiita Sekki no Bunpu. (Distributions of Olivine Basalt Artifacts in the southern Taiwan). *Records of Taiwan Geology* 111-8 (in Japanese).
- Li, D.-R. 1992. Tai Nan xian Ren De xiang Niu Chou Zi yi zhi shi jue bao gao (Report on the excavation of the Niuchouzi site, Rende of Tainan). Master dissertation, National Taiwan University, Taipei (in Chinese).
- Li, K.-C. 1983. *E Luan Bi gong yuan kao gu diao cha bao gao* (Report of archaeological investigations in the Eluanbi Park). Taipei: Administrative Bureau of the Kending National Park, Ministry of Interior Affairs (in Chinese).
- Li, K.-C. 1985. *Kending Guojia Gongyuan kaogu diaocha baogao* (Report of archaeological investigations in the Kending National Park). Taipei: Administrative Bureau of the Kending National Park, Ministry of Interior Affairs (in Chinese).
- Lien, C.-M. 2002. The Jade Industry of Neolithic Taiwan. *BIPPA* 6:55-62.
- Lien, C.-M. and W.-H. Sung. 1986. Yi zhi dui ji ceng ci ji wen hua ceng chu tu yi wu zhi fen xi yan jiu (Analytical studies of the stratification of the site and culture remains from habitation levels). Report of Excavation Data from the Beinan Site, 3, Unpublished Monograph, Department of Anthropology, National Taiwan University, Taipei (in Chinese). Taipei.
- Lien, C.-M. and W.-H. Sung. 1992. *Tai Wan di qu shi qian yi zhi zi liao dang* (The Files of Prehistoric Sites in Taiwan). Planning Bureau of National Prehistory Museum (in Chinese).
- Liu, K.-H. 1993. Xiao Liu Qiu yu shi qian yi zhi diao cha bao gao (Report on Archaeological Investigation of the Xiaoliuqiu Island). *Field Archaeology* 4(2):59-76 (in Chinese).
- Liu, Y.-C. 1982. Tai Bei xian Shu Lin zhen Gou Ti shan yi zhi (The Gou Ti Shan Site in Shulin of Taipei County). Master dissertation, National Taiwan University, Taipei (in Chinese).
- Liu, Y.-C. 1985. Bing Dong xian Pu Jiang shan yi zhi diao cha bao gao (Investigation Report on the Pujiangshan Site in Bingdong County). *Annals of Taiwan Provincial Museum* 28:1-25 (in Chinese).
- Liu, Y.-C. 1990. Tai Bei xian Jin Shan xiang Gui Zi shan yi zhi chu tu de xin zi liao (New findings from the Guizishan Site of Jinshanxiang, Taipei County). *Field Archaeology* 1(2):61-71 (in Chinese).
- Liu, Y.-C. 1993. *Yi Lan ian Da Zu Wei yi zhi chu bu diao cha bao gao* (Excavation of the Dazhuwei Site in Yilan County). Yilan: Yilan County Culture Center (in Chinese).
- Liu, Y.-C. 1996. *Tian ye diao cha ji tian ye fa jue shi shi bao gao* (Report of archaeological investigation and excavation). Taipei: Council Cultural Affairs (in Chinese).
- Liu, Y.-C. 1997a. *Tai Bei xian Bei Hai An di qu kao gu yi zhi diao cha bao gao* (Report of archaeological investigations in the northern coast of Taipei County). Taipei: Taipei County Culture Center (in Chinese).
- Liu, Y.-C. 1997b. *Dong xi xiang kuai su gong lu Han Bao Cao Tun xian Lin Cuo yi zhi diao cha qiang jiu ji hua - Shi ji diao cha bao gao* (Report on salvaged project of the Lincuo Site). Taipei: Institute of History and Philology, Academia Sinica (in Chinese).
- Liu, Y.-C. and Y.-M. Chen. 1997. *Gao Xiong xian li shi yu yi zhi* (History and archaeological sites in Gaoxiong County). Gaoxiong: County Government (in Chinese).
- Liu, Y.-C. and M.-Y. Qiu. 1995. *Dong bu hai an guo jia feng jing qu Lu Dao shi qian wen hua - diao cha yan jiu bao gao* (Report on the investigation of prehistoric culture of Ludao in Administrative Bureau of the eastern coast). Taipei: Institute of History and Philology, Academia Sinica (in Chinese).
- Liu, Y.-C. and B.-L. Wu. 1995. *Xue Ba guo jia gong yuan ren wen shi ji diao cha yan jiu* (2). *Da An xi, Hou Long xi shang you bu fen* (Investigation on the culture relics in the Xueba National Park, part 2). Taipei: Administrative Bureau of the Xueba National Park, Ministry of Interior Affairs (in Chinese).
- Liu, Y.-C. and F.-P. Yang. 1997. *Da Jia xi shang you shi qian yi zhi ji jiao qi yuan zhu min huo dong diao cha: part 1*. (Investigation report of the prehistoric sites and aboriginal activities of early stage in the upper Dajia River, part 1). Dongshi: Administrative Bureau of the Xueba National Park, Ministry of Interior Affairs (in Chinese).
- Luo, S.-Z. 1977. Zhu Shan si qian yi zhi diao cha (Investigations on the archaeological sites of Zhushan). In K.C. Chang (ed.) *Tai Wan sheng Zhuo Shui xi yu Da Du xi liu yu kao gu diao cha bao gao* (Archaeological investigations in the Zhuoshui and Dadu River Valleys of Taiwan), pp. 327-49. Taipei: Institute of History and Philology, Academia Sinica, *Special Publication No. 70*, (in Chinese).
- Renfrew, C. and P. Bahn. 1997. *Archaeology - Theories, Methods and Practice*. London: Thames and Hudson Ltd.
- Rolett, B.V., W.-C. Chen and J.M. Sinton. 2000. Taiwan Neolithic seafaring and Austronesian Origins. *Antiquity* 74:54-61.
- Rolett, B.V., C.-H. Tsang, H.-W. Yeh and H.C. Hung. n.d. Qimei: A Neolithic Quarry Island in southeast China. Unpublished.
- Shi, Z.R. and Y.-C. Liu. 1987. *Damalin*. Taipei: Institute of History and Philology, Academia Sinica (in Chinese).
- Sun, B.-G. 1977. Yu Chi xiang de kao gu diao cha (Archaeological investigation in Yuchi). In K.C. Chang (ed.) *Tai Wan sheng*

- zhuo shui xi yu Da Du xi liu yu kao gu diao cha bao gao (*Archaeological investigations in the Zhuoshui and Dadu River Valleys of Taiwan*). pp. 327-49. Taipei: Institute of History and Philology, Academia Sinica, *Special Publication No. 70* (in Chinese).
- Sung, W.-H. 1955. *Ben xi jiu cang Yuan Shan shi qi-2 (Collection of Stone Tools from the Yuanshan Site in Anthropology Department of National Taiwan University, Part 2)*. Taipei: National Taiwan University, *Bulletin of the Department of Anthropology*, 5:44-58 (in Chinese).
- Tan, L.P., C.-M. Lien and B.C. Yu. 1997. Tai Wan Bei Nan yi zhi chu tu yu qi cai liao lai yuan zhi chu bu yan jiu (Preliminary study on the source of nephrite in the Beinan Site of Taiwan). Taipei: National Taiwan University, *Bulletin of the Department of Anthropology* 52:211-20 (in Chinese).
- Tsang, C.-H. 1977. Nan Tou xian Wu xi he gu kao gu diao cha (Investigation in the Wu Valley of Nantou County). In K.C. Chang (ed.), *Tai Wan sheng Zhuo Shui xi yu Da Du xi liu yu kao gu diao cha bao gao (Archaeological investigations in the Zhuoshui and Dadu River Valleys of Taiwan)* pp. 327-49. Taipei: Institute of History and Philology, Academia Sinica, *Special Publication No. 70* (in Chinese).
- Tsang, C.-H. 1984. Ding Kan Zi yi zhi shi jue bao gao (Report on the excavation of the Dingkanzi Site). Taipei: Academia Sinica, *Bulletin of the Institute of History and Philology* 55(3):567-601 (in Chinese).
- Tsang, C.-H. 1992. *Archaeology of the Penghu Islands*. Taipei: Institute of History and Philology, Academia Sinica, *Special Publication No. 95* (in Chinese).
- Tsang, C.-H. 1994. Jiu Jiu Feng xia de shi qian yi zhi (Prehistoric sites on the foot of Jiujiu Feng Hills). Taipei: Institute of History and Philology, Academia Sinica. (unpublished mss) (in Chinese).
- Tsang, C.-H. 2000. *The Archaeology of Taiwan*. Taipei: Council Cultural Affairs Executive Yuan.
- Tsang, C.-H. 2003. Gao su tie lu Nan Ke duan You Xian Fang yi zhi qian gjiu ji hua qi mo bao gao (Report on salvaged project of the Youxianfang Site). Taipei: Institute of History and Philology, Academia Sinica. (unpublished mss) (in Chinese).
- Tsang, C.-H., and K.-J. Chang. 1995a. Ceng Wen xi liu yu shi qian ju luo xing tai he sheng tai shi ying 2. Ceng Wen xi shang you liu yu kao gu diao cha (Prehistoric settlement patterns and environmental adjustments in the Cengwen Valley, part 2: Archaeological investigation of the upper Cengwen River Basin). In C.H. Zhou (ed.), *A study of environmental changes and resource management in western Taiwan, part 1 - research report of the Cengwen Valley*. Taipei: Institute of History and Philology, Academia Sinica. (unpublished mss) (in Chinese).
- Tsang, C.-H., and K.-J. Chang. 1995b. Ceng Wen xi liu yu shi qian wen hua yi zhi yi wu zheng li ji Jia Yi xian Ali shan xiang Yingiana yi zhi shi jue jian bao (Brief report on the prehistoric culture artifacts of the Cengwen River Basin and the initial excavation of the Yingiana Site at Alishan, Chiayi County). In C.H. Zhou (ed.), *A study of environmental changes and resource management in western Taiwan, part 1 - research report of the Cengwen Valley*. Taipei: Institute of History and Philology, Academia Sinica. (unpublished mss) (in Chinese).
- Tsang, C.-H., and H.-C. Hung. 2001. Peng Hu Qi Mei 3 shi qian shi qi zhi zao chang de fa xian he chu bu yan jiu (A preliminary study on three Lithic Workshops found on the Chimei Island, Penghu). Taipei: Academia Sinica, *Bulletin of the Institute of History and Philology* 72(4):889-940 (in Chinese).
- Tsang, C.-H., Y.-C. Liu and C.-Y. Chu. 1990. Tai Wan bei hai an xin fa xian de Wanlijiatou yi zhi - jian shu lin jin de Gui Zi Shan yi zhi (The newly discovered Wanlijiatou Site on the northern coast of Taiwan, near Guizishan site). *Field Archaeology* 1990(1):27-36 (in Chinese).
- Tsang, C.-H., Y.-C. Liu and C.-Y. Chen. 1994. *Tai Min di qu kao gu yi zhi Gao Xiong xian and Gao Xiong shi (Investigation of the archaeological sites in Taiwan - Gaoxiong City and Gaoxiong County)*. Taipei: Ministry of Interior Affairs (in Chinese).
- Wang, Z.-M., C.-M. Lien, W.-X. Song, Z.-F. Yu and Z.-H. Chen. 1996. Bei Nan yi zhi chu tu yu qi kao gu xue kuang wuxue Yan jiu (Archaeological and mineral study on the nephrite artifacts from Beinan Site). In *Handbook of the International Conference for the Mineral Study of Ancient Nephrite*, pp. 13-8. Taipei: National Taiwan University.

APPENDIX 1 (OVER PAGE):

Archaeological site names used in this report (in alphabetical order, using pinyin spelling).

HUNG: A SOURCING STUDY OF TAIWAN STONE ADZES

Site name in pinyin	Site name in previous reports	Site name in Chinese
Baishoulian	Paishoulien	白守蓮
Bajiacun	Pachia	八甲村
Baxiandong	Pahsientung	八仙洞
Beinan	Peinan	卑南
Beiye	Peiyieh	北葉
Caoton-Pinglin-IV	Pinglin IV, Tsaotun	草屯平林 IV
Dabengkeng	Tapenkeng	大盆坑
Dahu	Tahu	大湖
Damalin	Tamalin	大馬璘
Danman	Tanman	膽曼
Dapingding	Tapinting	大坪頂
Daqiuyuan	Tachiuyuan	大邱園
Dayuanjianshan	Tayuanchiengshan	大園尖山
Dazhuwei	Tachuwei	大竹圍
Dingjie	Tingchieh	頂街
Dingkanzi	Tingkantzu	頂坎子
Donghe-I	Tunghe- I	東河
Dongjiao	Tungchiao	洞角
Dongpu zone 1	Tungpuz zone 1	東埔一鄰
Doulan	Tulan	都蘭
Doulan- II	Tulan- II	都蘭
Eluanbi-I	Oluanpi—I	鵝鑾鼻
Eluanbi-II	Oluanpi-II	鵝鑾鼻
Fengbitou	Fengpitou	鳳鼻頭
Fushan	Fushan	富山
Goutishan	Koutishan	狗蹄山
Guizishan	Kweitzushan	龜子山
Guoye	Kuoyeh	菓葉
Guweishan	Huweishan	鵲尾山
Hunei	Hunei	湖內
Jialulan	Chialulan	加路蘭
Kending	Kenting	墾丁
Liangwengang	Liangwengkang	良文港
Wangan-Liyushan	Wangan Liyushan	望安鯉魚山
Mazhuling	Mazchuling	麻竹嶺
Nangang	Nankang	南港
Neilu	Neilu	內轆
Niumatou	Niumatou	牛罵頭
Nichouzi	Nichoutzu	牛稠子
Niupu	Niupu	牛埔
Qubing	Chuping	曲冰
Shagang	Sakang	沙港
Shisanxing	Shihsanhang	十三行
Suicheding	Shuicheting	水車頂
Suogang	Suokang	鎖港
Taibalang	Taipalang	太巴塢
Taiyuan	Taiyuan	泰源
Tianliaoyuan	Tianliaoyuan	田寮園
Tudigongshan	Tutikungshan	土地公山
Wanlijiao	Wanlichiatou	萬里加投
Wanrong-Pinglin	Wanrung Pinglin	萬榮坪林
Wuxian- II	Wuhsien- II	五線
Xinliucun	Hsinliutsun	新六村
Yingpu	Yingpu	營埔
Youzihu	Youtzuhu	油子湖
Yuanshan	Yuanshan	圓山
Yuemei I	Yuehmei I	月眉
Yuemei II	Yuehmei II	月眉
Zhishanyan	Chihshanyan	芝山岩