**Sembiran and Pacung on the northern coast of Bali: a strategic crossroads for early trans-Asiatic exchange**

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*Studies of trade routes across Southeast Asia in prehistory have hitherto focused largely on archaeological evidence from Mainland Southeast Asia, particularly the Thai Peninsula and Vietnam. The role of Indonesia and Island Southeast Asia in these networks has been poorly understood, owing to the paucity of evidence from this region. Recent research has begun to fill this void. New excavations at Sembiran and Pacung on the northern coast of Bali have produced new direct AMS dates from burials and analytical data from cultural materials including pottery, glass, bronze, gold and semi-precious stone, as well as evidence of local bronze-casting. This suggests strong links with the Indian subcontinent and Mainland Southeast Asia from the late first millennium BC, some 200 years earlier than previously thought.*

*Keywords:* Island Southeast Asia, Bali, prehistoric trade networks, bronze, gold, glass, carnelian, Rouletted Ware

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**Radiocarbon dating**

Ten new radiocarbon dates have been obtained as part of this study and are given in Table S1, where they are compared to published dates.

Collagen preservation is poor at Pacung and Sembiran, and so %N remaining in the bone was used to identify which bones were most likely to be dateable (Brock *et al*. 2012). Unfortunately, none of the 27 human bones screened from Sembiran were dateable, so charcoal higher in the stratigraphic sequence was dated. Bone samples were treated with an ultrafiltration protocol (e.g. Brock *et al*. 2010) and the charcoal was treated with an acid-base-acid protocol prior to dating by AMS (Fallon *et al*. 2010).

All dates, including the previously published dates, have been calibrated in OxCal v.4.2 (Bronk Ramsey 2009a). The enriched δ13C values suggest people at Pacung may have eaten a small amount of marine food. However, C4 plants are common in Bali and will also cause an enrichment in δ13C, complicating the identification of marine food. The only exception is the tooth from PCN III, which has stable isotope values indicative of a fully C3-based terrestrial diet, a point which, coupled with mtDNA results, contributed to the suggestion (Lansing *et al*. 2004) that the tooth may have belonged to a foreigner. As food-webs are longer within the marine environment, people eating marine food tend to have enriched δ15N values. At Pacung, δ15N is not unusually enriched (e.g. Richards & Hedges 1999), hinting that the enriched δ13C is primarily derived from C4 plants. This conclusion is supported by stable isotope analysis of enamel on six human teeth from Pacung, which range from –12.2 to –9.8 %. We have therefore assumed that 15±10% of the carbon within the dated collagen is derived from marine resources. This is considered the minimum amount of marine carbon, and gives the maximum probable age. Dates on these human bones have been calibrated against a combination of the SHCal13 (Hogg *et al*. 2013) and MarineCal13 (Reimer *et al*. 2013) curves. A ΔR of 47±38 has been calculated from data in Southon *et al*. (2002, 2013), Guilderson *et al*. (2008) and Fallon *et al*. (2010). All other dates have been calibrated against SHCal13 (Hogg *et al*. 2013). Radiocarbon dates from the burials at Pacung have been modelled in OxCal v.4.2 on the assumption that the burials were part of a single phase of activity. All dates were ascribed a 5% prior probability of being an outlier within the *General t-type Outlier Model* (Bronk Ramsey 2009b).

Two dates on charcoal from 2.9–3.0m depth in SBN XIX (S-ANU 33928 and 37106) gave ninth to tenth century age ranges, which correspond to the dating of the 2.2–2.5m depth above (S-ANU 33210; ANU 7218). Based on the cultural materials, and on another date from 2.9–3.0m depth in SBN XIX of 142 cal BC–AD 25 (S-ANU 37107), the younger charcoal fragments at this depth are considered to be intrusive from the sediment above.

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**Table S1. Radiocarbon dates from Pacung and Sembiran.**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Radiocarbon results** | | | | **Quality assurance and**  **Isotope Ratio-Mass Spectrometry (IRMS)** | | | | | |
| **Sample** | **Material** | **Lab. code** | **14C age (BP)** | **Calibrated date (95.4% probability**  **cal BC/cal AD)** | **δ13C1**  **PDB** | **Collag.**  **(mg)** | **Collag. (%)** | **δ13C PDB** | **δ15N AIR** | **%C** | **C:N** |
| **Pacung (PCN)** | | | | | | | | | | | |
| PCN IX  B. XVIII:  375cm | bone | S-ANU 33209 | 2090±34 | 131 cal BC–AD 115 | –15±2 | 3.7 | 0.73 | –17.9 | 8.1 | 41 | 3.2 |
| PCN IX  B. XVI:  405 cm | bone | S-ANU 35428 | 2030±30 | 54 cal BC–AD 200 | –15±2 | 21.1 | 2.8 | –17.2 | 7.5 | 45.2 | 3.3 |
| PCN IX  B. XIX: 395cm | bone | S-ANU 37114 | 2030±25 | 52 cal BC–AD 197 | –16±2 | 12.4 | 2.2 | –17.2 | 9.8 | 39.2 | 3.3 |
| PCN VI  B. V: 378cm | bone | S-ANU 35429 | 2070±30 | 95 cal BC–AD 121 | –13±2 | 9.5 | 1.7 | –18.2 | 7.5 | 45.2 | 3.3 |
| PCN IX  B. XV: 420cm | bone | S-ANU 35427 | 2030±30 | 54 cal BC–AD 200 | –16±2 | 18.2 | 2.3 | –16.5 | 8.9 | 44.0 | 3.3 |
| PCN IV  B. VI: 439m | bone | KIA 251254 | 2090±25 | 109 cal BC–AD 782 | –17.1±0.1 |  |  |  |  |  |  |
| KIA 251264 | 2103±25 | –17.4±0.3 |  |  |  |  |  |  |
| PCN III  below 3.5m | dentine | Beta 1619205 | 2110±40 | 201 cal BC–AD 21 |  |  |  | –21.1 |  |  |  |
| PCN IX  E5-  4.2-4.3m  B. XIII context | charcoal | S-ANU 37113 | 2110±25 | 196 cal BC–AD 16 |  |  |  |  |  |  |  |
| **Sembiran (SBN)** | | | | | | | | | | | |
| SBN XIX  C1-  2.9-3m | charcoal | S-ANU 37107 | 2085±30 | 142 cal BC–AD 25 | –25±2 |  |  |  |  |  |  |
| SBN VI  2.5m | charcoal | ANU 7218 | 1010±110 | cal AD 861–1279 |  |  |  |  |  |  |  |
| SBN XIX  D1-  2.1-2.2m | charcoal | S-ANU 33210 | 1015±30 | cal AD 1020–1150 | –20±2 |  |  |  |  |  |  |
| SBN XIX  B3-  2.9-3m | charcoal | S-ANU 371066 | 1180±25 | cal AD 876–989 | –24±2 |  |  |  |  |  |  |
| SBN XIX  D2-  2.9-3m | charcoal | S-ANU 339286 | 1190±25 | cal AD 790–987 | –25±1 |  |  |  |  |  |  |
| SBN VII  3.5m | rice husk | CAMS 7237 | 2660±100 | 993 cal BC–429 BC |  |  |  |  |  |  |  |
| **Notes**  1) δ13C measured by AMS is not comparable to IRMS results; 2) two dates on the same individual produced an identical date (χ2, p<0.05), the weighted average of the conventional dates has been calibrated; 3) low collagen yield. However, the C:N ratio does not suggest gross contamination; 4) Swastika 2008; 5) Lansing *et al*. 2004, 2006; 6) This charcoal is considered to be intrusive from the 2.2–2.5m sediment above, which is dated to the same period; 7) Ardika & Bellwood 1991. | | | | | | | | | | | |