Research Article

ARCHAEOLOGICAL SALT PRODUCTION AT THE BALENI SPRING, NORTHEASTERN SOUTH AFRICA

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ABSTRACT

Baleni is a mineral spring in the South African Lowveld where radiocarbon and ceramic evidence indicates a 2000-year salt-production record. Excavations have found that episodic production during this period closely mirrored that of more recent ethnographic accounts. Use-alteration of ceramics clearly indicates the important role these vessels played in the production process.

Key words: salt production, Iron Age, farming communities, ceramics, use-alteration, Mzonjani, Eiland, Letaba.

INTRODUCTION

Baleni (also known as Sautini) is a mineral spring in northeastern South Africa where archaeological excavations uncovered evidence of salt extraction dating back approximately 2000 years (Antonites 2005). Historically, locally produced salt was traded over great distances across the South African interior (Dicke 1937; Evers 1974, 1979, 1981; Harries 1978; De Vaal 1985). Today, however, Baleni is the last remaining spring where small-scale, unmechanised salt production still takes place. This paper will use ethnographic observations of salt making at Baleni, as well as comparable sites elsewhere in Africa, to discuss salt production and its archaeological correlates at this site.

SOURCE OF THE SALT AND ENVIRONMENTAL SETTING

Baleni is situated on the southern bank of the Klein Letaba River, around 20 km east of the town of Giyani (Fig. 1). The region forms part of the South African Lowveld – the low-lying Bushveld east of the Drakensberg escarpment and west of the Lebombo Mountains on the South Africa-Mozambique border.

At Baleni, water from the main spring eye flows into a reed-covered swamp roughly 250 m in length and 50 m across (Fig. 2). The swamp, in turn, drains into the Klein Letaba through a small outlet on its northern edge. Water temperature close to the surface measures around 30°C. The water has a high mineral content, with sodium chloride (NaCl) the predominant constituent (Kent 1986). The source of the thermal water is a geological fault and its associated shear zones, which act as a deep aquifer. At depths of up to 1000 m, the water in the aquifers takes up heat from the earth's crust and returns to the surface at a high enough speed to retain this heat. It is also at this depth where the water acquires much of its mineral content from the surrounding geology (Kent 1986).

ARCHAEOLOGICAL BACKGROUND

Baleni, and sites such as Eiland, Harmony, Rhoda and Loole (Schwellnus 1937; Mason 1962; Evers 1974), are salt-production centres located within 80 km of one another (Fig. 1). At all of these sites, salt production is associated with farming communities (commonly also referred to as Iron Age communities). Scientific interest in these Lowveld sites dates back to the first half of the 20th century (Schwellnus 1937; Bates 1947). These early accounts mostly reported on the ancient remains of salt production around these springs, since traditional forms of production had long since ceased. In later years, however, it was found that small-scale production still took place at the Baleni spring, and continues to this day (Witt 1966; Terblanche 1994).

Archaeological research on these salt-production sites is limited to excavations by Evers (1974, 1979, 1981) in the 1970s at Harmony and Eiland. At Harmony, Evers (1974, 1979) showed a direct link between the salt-production site, a nearby soapstone bowl factory site, and a late second millennium farmer settlement, located 1.6 km away. Evers (1974) further noted that the Harmony and Eiland archaeological deposits were very similar. Both sites contained mostly ceramics, bone, charcoal and ash, with some soapstone bowl fragments, which suggested similar salt-production methods. Excavations at Eiland produced

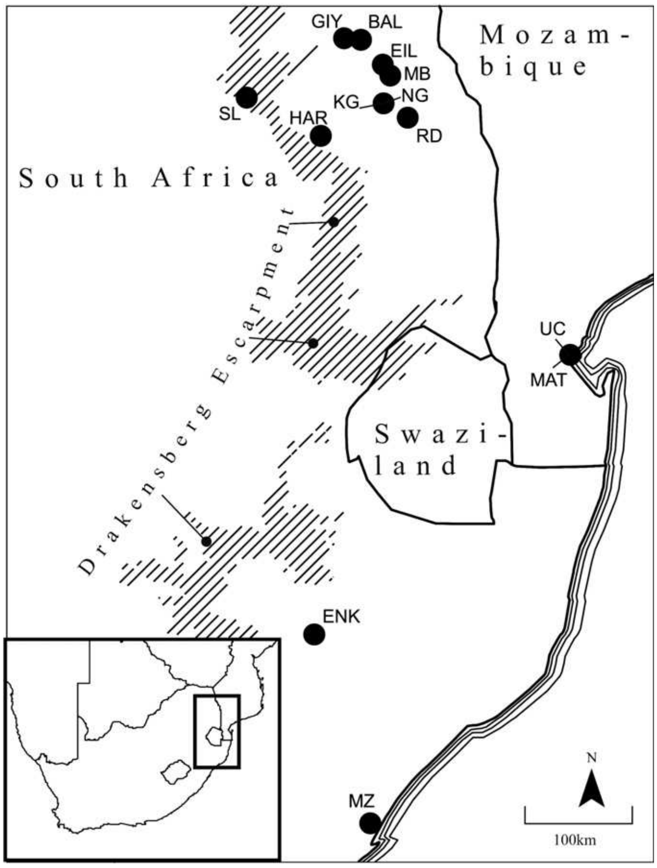

FIG. 1. *The location of Baleni and major sites mentioned in the text. BAL = Baleni, EIL = Eiland, ENK = Enkwazini, GIY = Giyani, HAR = Harmony, KG = Kgopolwe, MAT = Matola IV, MB = Mabete, MZ = Mzonjani, NG = Nagome, RD = Rhoda, SL = Silver Leaves, UC = University Campus.*

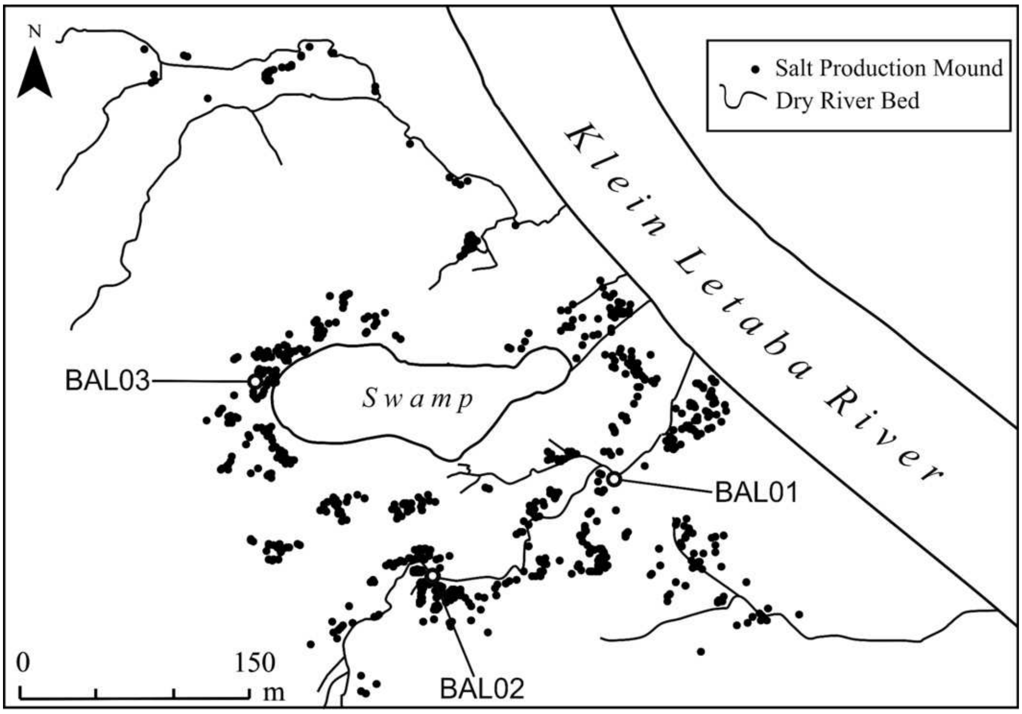

FIG. 2. *The Baleni swamp and ancient salt-production mounds.*

three radiocarbon dates of 1590 ± 40 BP (Pta-1607), 1630 ± 30 BP (Pta-1608), and 1680 ± 30 BP (Pta-1524). These dates, together with the ceramic data, indicated that production took place from at least the fourth century AD onward. Only one radiocarbon date was submitted from the Harmony excavations (320 BP [RL-206]), suggesting a 17th century date. In the absence of a reported error range,[1] calibration on the radiocarbon curve is not possible. The ceramic data do, however, point to production activities from as early as the fourth century AD.

Evers' excavations at Harmony and Eiland were crucial in establishing a ceramic sequence for northeastern South Africa, since these sites were well stratified and covered a long period of exploitation. He identified three ceramic style phases at both sites: an early first millennium Silver Leaves phase, an early second millennium Eiland phase and a post-16th century Letaba phase (see 'Style typology').

HISTORICAL DESCRIPTIONS OF SALT PRODUCTION

A large body of ethnographic and historical examples of salt production throughout sub-Saharan Africa complements the archaeology of salt production. I will briefly discuss some comparative production methods before moving to the Baleni example.

SALT PRODUCTION IN SUB-SAHARAN AFRICA

The basic process described at Baleni is very similar to production at salt springs elsewhere in Africa (e.g. Fagan & Yellen 1968; Gouletquer 1975; Sutton 1981; Connah 1991; Alexander 1993; Davison 1993; Matshetshe 1998). In essence, the process revolves around leaching salt-rich material (such as soil or plant ash) to make brine, and reducing it into crystalline salt. Although brine can be obtained directly from the water of saline springs (e.g. Sutton & Roberts 1968; Lovejoy 1986), it is more commonly produced by leaching salt-rich material. A variety of leaching methods are employed throughout the continent but the most common are leaching through either perforated ceramic strainers or basket-type filters (Junod 1927: 35; Mason 1962; Stayt 1968: 47–48; Connah *et al*. 1990: 33; Davison 1993: 12–13). The clearest evidence for the former are discarded ceramic fragments with drilled holes, although plastic and metal containers replaced these in more recent times (Grey 1945). In some cases, soapstone bowls served as more permanent filtering containers. More intensive extraction is often associated with filtering brine through woven basket filters. Strainers of this type have been described from regions as far afield as Ghana (Sutton 1983), Niger (Gouletquer 1975), Sudan (Lovejoy 1986), Malawi (Davison 1993), Tanzania (Fagan & Yellen 1968) and South Africa (Junod 1927; Witt 1966; Stayt 1968). Although these filters vary in size, they are all more or less funnel shaped and suspended above the ground from a wooden frame.

The resultant brine is typically reduced to salt by means of slow boiling over an open fire (Witt 1966; Stayt 1968; Evers 1981; Connah *et al*. 1990). As the liquid evaporates, it is topped until it acquires a porridge-like consistency. Despite the seeming simplicity, brine boiling is an exacting task, since it is quite easy to burn the salt (Witt 1966). The salt maker carefully monitors the changing nature of the crystallisation process in order to remove the mixture from the fire at the appropriate stage. At Kibiro in Uganda for example, Connah *et al*. (1990) found that brine boiling can take as little as two hours when small batches of salt are made; although in one case, it took four and a half hours to reduce 6.4 litres of brine to 1.4 litres of salt (Grey 1945).

In some cases, boiling vessels are little more than moulds and are broken to remove the salt after a single use (Gouletquer 1975; Lovejoy 1986; Parsons 2001: 214). Most boiling vessels, however, are re-used, and range from wide-mouthed pots used exclusively for salt boiling (e.g. Grey 1945; Sutton & Roberts 1968; Cardale-Schrimpff 1975; Muller 1984) to vessels indistinguishable from typical domestic wares (Grey 1945; Fagan & Yellen 1968; Connah 1991).

A review of the literature highlights two important archaeological considerations. First, prolonged salt production from salt-rich soil universally results in earthen mounds of leached out material and debris, typically located next to the filter (Witt 1966; Gouletquer 1975; Lovejoy 1986; Davison 1993). As a result, salt-production sites are often discernible as a concentration of

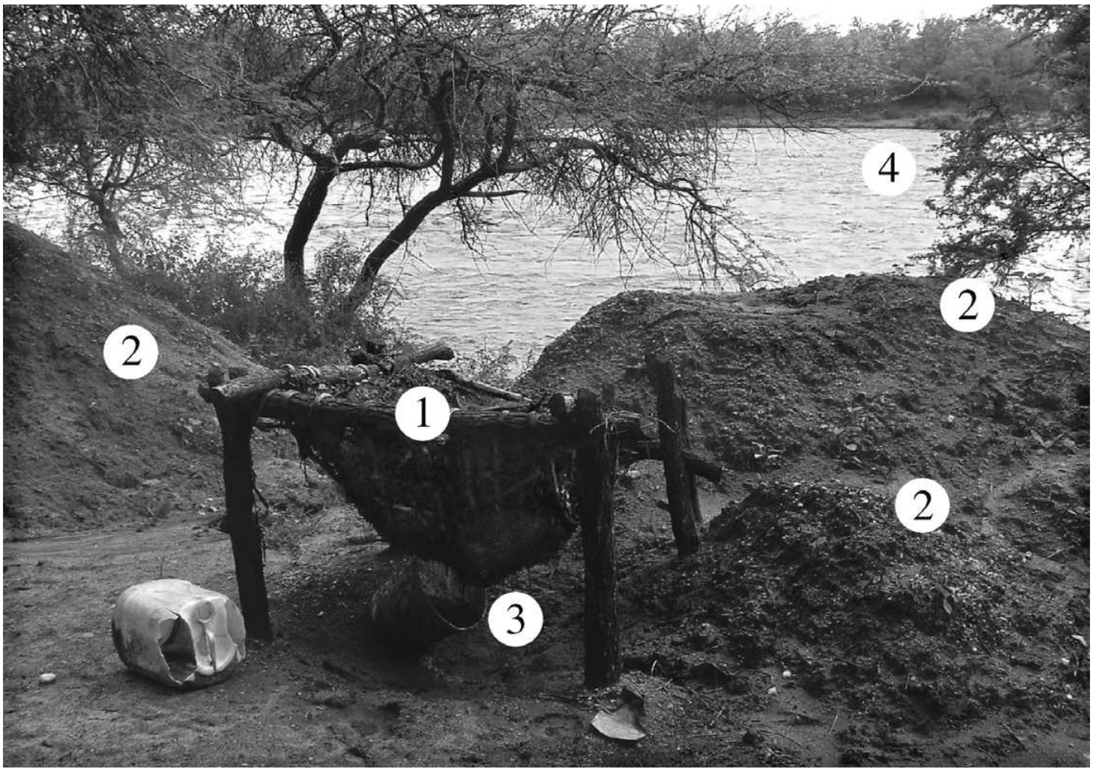

FIG. 3. *Recently abandoned salt-production workshop with* (1) *salt filter strainer,* (2) *mounds of leached soil,* (3) *receptacle for leached brine,* (4) *Klein Letaba River.*

conspicuous soil mounds. Second, ceramic vessels used in the boiling and collection process have a very short lifespan. This is due to physical stresses placed on ceramics by the highly caustic brine, as well as heat from the fire during boiling. As a result, production sites contain large quantities of ceramic sherds that usually end up on debris mounds.

SALT PRODUCTION AT BALENI

At Baleni, ethnographic descriptions by Witt (1966) and Terblanche (1994), and more recent personal observation (Antonites 2005), provide a local backdrop to the archaeological record. Here, salt production is a dry season activity, which occurs from May to September in the northern Lowveld. The precise day on which production starts is decided beforehand through consultation with ancestral spirits (Witt 1966; Terblanche 1994: 194). On that day, a ceremony takes place in which the spirits are implored for a successful salt-making season. This usually involves the placing of offerings (bundles of sticks, food, tobacco, snuff or copper coins) at the base of a certain dead leadwood tree (*Combretum imberbe*) near the northern edge of the swamp (*cf.* Terblanche 1994: 195; the earlier account by Witt [1966] does not specifically mention the presence of the tree during the ceremony, while Evers [1981] refers to a dead marula tree). It seems that salt production in the past was exclusively a female activity and men were not allowed close to the site – more recently, however, this taboo has fallen away and the presence of men is now tolerated (*cf.* Terblanche 1994: 193).

In 1966, Witt observed that saltworkers brought sleeping mats with them and that they erected temporary structures when making salt. However, neither Terblanche (1994) in 1984, nor myself in 2003 and 2004 could locate such structures during the production season (see also Evers 1981). This trend was confirmed by salt makers who, when questioned by Terblanche (1994: 196) said that they return home at night, bringing with them essentials and food for a day only.

The first step in the production process is the collection of salt-rich earth around the Baleni swamp. During the dry winter months the water levels in the swamp recede, leaving behind a white salt-rich crust on the newly exposed surface. It is this crust that salt makers collect and place into a basket-type filter to be strained. The strainer itself is built by first planting four forked poles, approximately 40–60 cm apart, to form a square. A frame is placed in the forks and tied together using bark. A funnel-shaped basket of bark and thin branches is then woven onto this frame so that it is suspended above the ground. The basket's interior is built up into a cone shape using clay, leaving only a small hole in the bottom through which water can drip. This hole is usually covered with dry grass or leaves.

The collected salt crust is often mixed with an equal amount of river sand. The river sand loosens the texture of the gathered crust, which would otherwise be too clayey. A suitable quantity of this mixture is then placed in the filter. Once in the filter, water is poured over the mixture. This process is repeated until the receptacle underneath the filter is filled with the saltwater extraction. After water has been poured over the salt-soil mixture two or three times, the content of the filter is scraped out and discarded next to it (Fig. 3). Continued production results in large mounds of leached-out material emptied from the filter – similar to salt-production sites elsewhere in Africa. These mounds also contain food remains and other debris, which in the past included ceramic vessels broken during production (plastic and metal containers have replaced these in modern production). The net effect is a highly altered landscape, pockmarked with old debris mounds and the remains of ancient salt production.

The final step in the production process is the reduction of collected brine into salt crystals. The saltwater mixture is slowly boiled so that the water evaporates, leaving behind only moist salt. Until recently, the final product was moulded into cones weighing between 1–2 kg. These cones were formed by ladling the still damp salt with the hands (Terblanche 1994: 198; see also Connah 1991; Gouletquer 1975 for comparable African examples). At times, the salt makers placed hot coals on the cone to form a hard crust on the surface (Terblanche 1994: 200). The cone could also be placed on dry grass, which is then set alight to produce the same effect. Witt (1966) mentions a process where the cone is simply placed in the sun in order for it to dry, and then baked in a clay pot placed on a fire. Today, however, salt is mostly sold as loose crystals in small plastic containers in the nearby town of Giyani.

Salt makers provide different reasons for the cone shape, with ease of transport and trade being the most compelling (Terblanche 1994: 199–200). Elsewhere in Africa, people mostly transported salt in the form of hard cakes, cylinders and cones (e.g. Gouletquer 1975; Lovejoy 1986, Connah *et al*. 1990).

SURVEY OF THE PRODUCTION AREA

Survey of the Baleni landscape indicated that production mounds occur in a zone approximately 250 m around the swamp (Fig. 2), with a few outlying mounds up to 1.5 km away. In total, 730 production mounds were recorded with the highest concentration along the southern, eastern and western edges of the swamp. This number is a palimpsest of production activities rather than singular events. The effect of overlapping activity areas is clearest along the western edge of the swamp. Here numerous mounds have formed on top of each other to create embankments of production debris mounds in excess of two metres in height.

EXCAVATIONS OF SALT WORKSHOPS

Three separate debris mounds were excavated in 2004. Two of these excavations, BAL01 and BAL02 were conducted on single debris mounds around 50 m from the swamp's edge. The excavation trench BAL03 was placed over a large embankment area, around 10 m from the swamp's western edge. In all three instances, ceramic vessels were the most abundant artefact category excavated. Besides a small faunal sample, the only other cultural artefact was a single glass bead from BAL03.

EXCAVATION BAL01

BAL01 was a single 1.5 m by 1.0 m trench placed on the bank of a perennial stream that flows into the Klein Letaba River. Horizontal movement of the stream channel continually cuts into the production mounds on its banks. At BAL01, this process had exposed a mound with numerous early first millennium farmer ceramics visible in the profile. Excavation into the bank revealed a straightforward stratigraphy of only two strata above sterile palaeosoil (Fig. 4). The ceramic data suggest that BAL01 was the result of a single production event. The upper layer probably resulted from biological activity and continuous reworking of soils, while the lower layer is directly associated with salt production. However, the original mound clearly deflated over time, and all the material associated with this event consolidated into a single layer.

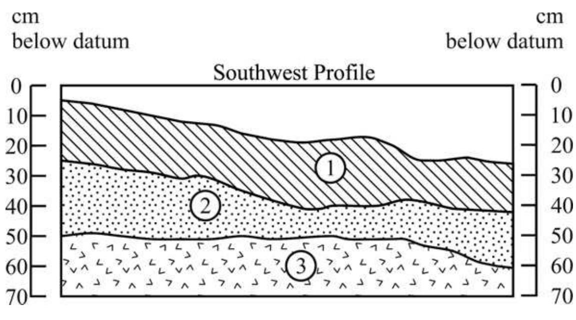

FIG. 4. *Southwest profile of BAL01. Numbers refer to stratigraphic layers:* (1) *homogeneous, organic dark brown loam;* (2) *grey-brown loam with numerous ash lenses;* (3) *sterile paleosoil.*

EXCAVATION BAL02

BAL02 was a 1.8 m by 0.5 m trench placed 300 m west of BAL01, on the southern bank of the same stream. Like BAL01, the movement of the stream channel had cut into a mound exposing archaeological material in profile. A similar excavation method was followed as for BAL01. The exposed profile displayed a complex mound-like stratification and contained numerous well-defined lenses and pockets of river sand, ash and charcoal (Fig. 5). Ceramics from this mound were all classed as typical of the Letaba ceramic style – elsewhere dated to post-AD 1600 (see 'Excavation BAL03'). The strata suggest that the internal layers were not exposed for very long and that the mound was probably the result of a single production event.

EXCAVATION BAL03

BAL03 was a 2 m by 1.5 m unit placed along the south-western edge of the swamp, where concentrated salt production had formed a large embankment. Excavations ended on a solid bed of schist, 2.1 m below the surface. Excavations revealed five distinct salt-making events – with Event 1 the most recent and Event 5 the oldest. Each event is visible as a mound-like stratum, which formed through the rapid deposition of material and is associated with a temporally distinct ceramic phase. When the combined profile plans are viewed in axonometric projection, the mound-like character of the deposit is clearly visible (Fig. 6). Each event contained organic remains that were submitted for radiocarbon dating[2]. The samples yielded calibrated dates ranging from the early first millennium AD up to recent times – therefore covering the entire period typically associated with Bantu-speaking farming communities in southern Africa.

EVENT 1

The most recent salt-production event comprised the top 60 cm of the excavation. The deposit was mostly a uniform yellowish-dark brown, sandy loam interspersed with small ash lenses with gravel inclusions throughout. Charcoal samples from 50–60 cm below datum were collected and dated to 310 ± 45 BP (Pta-9340). However, the event is associated with Letaba-style ceramics, which conforms to a post-17th century date for this production episode (Evers & Van der Merwe 1987; Loubser 1991). The presence of a single cobalt blue hexagonal glass bead – a type imported through Portuguese trade ports along the East African Coast during this period (Evers 1974) – further confirms this date range.

EVENT 2

The second depositional event was also associated with Letaba ceramics. A series of diagonal stratigraphic layers, which are most visible in the southern profile, characterise this event. A mound-like stratification sloping in an east–west direction is clearly visible. The radiocarbon sample for this event was collected from 100–110 cm below datum and dated to 270 ± 45 BP (Pta-9351). Although this radiocarbon date is slightly younger than the preceding Event 1, the calibrated ranges of the two dates greatly overlap (see Fig. 12).

EVENT 3

As opposed to the numerous small strata and lenses of the previous event, Event 3 contained a primary layer of dark brown sandy loam. This layer was visible in the eastern, southern and northern profiles, with smaller well-defined layers of orange and red clay abutting it. Interspersed within the deposit were layers and lenses of well-defined coarse orange sand and very

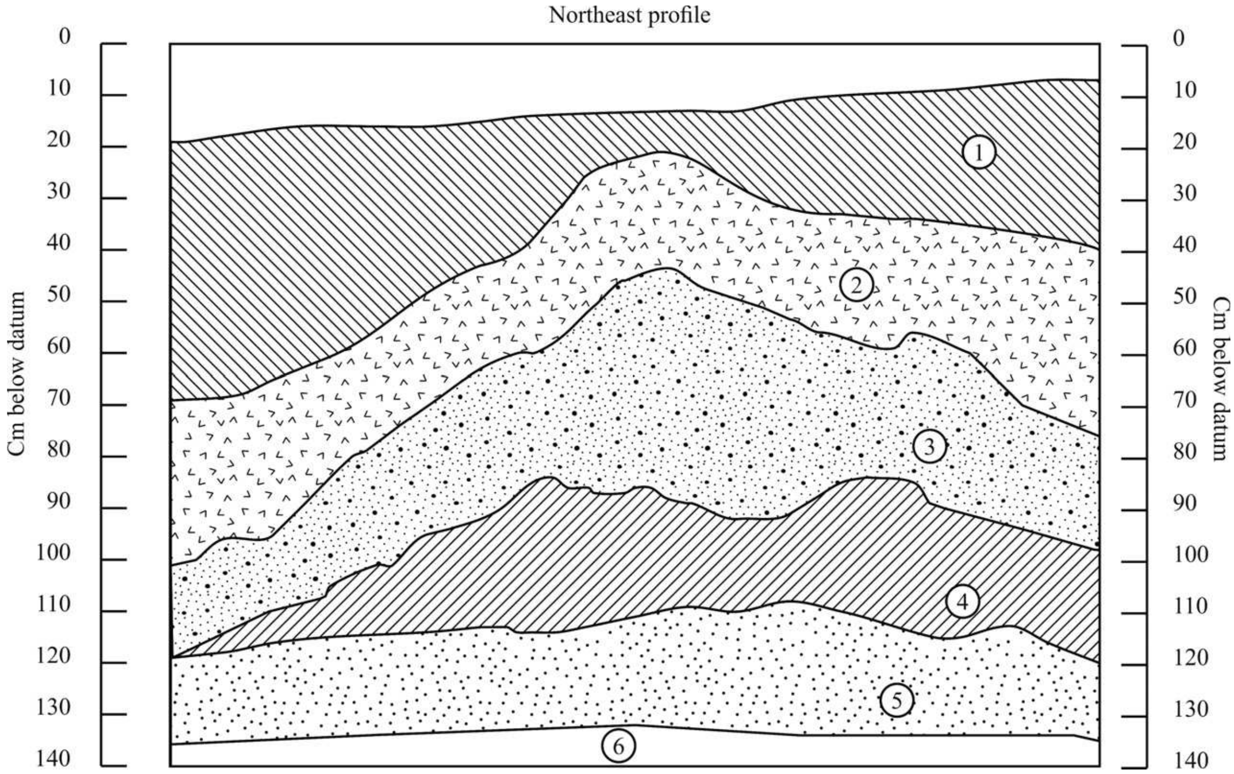

FIG. 5. *Northeast profile of BAL02. Numbers refer to stratigraphic layers:* (1) *dark brown loamy topsoil;* (2) *loam with ash lenses and pockets of yellow sand;* (3) *heterogeneous matrix varying between brown loam and grey sandy-loam;* (4) *brown loam with pockets of light grey ash;* (5) *course orange river sand with artefacts;* (6) *sterile soil.*

fine light grey ash with charcoal inclusions. This event is associated with Eiland ceramics and a carbon sample from 130 cm below datum was collected and dated to 520 ± 50 BP (Pta-9341). This date is later than most Eiland assemblages and some explanations are considered below.

EVENT 4

The fourth event contained ceramics associated exclusively with early farming communities from the early first millennium AD. This uniform sandy-loam layer was a dark orange-brown colour with darker and reddish brown inclusions. Pockets of grey soil indicated the remnants of ash lenses that had fused with the surrounding sandy loam matrix. The limits of the inclusions were poorly defined and the entire event had a diffuse character caused by ground water seepage. A carbon sample from this event was dated to 1700 BP ± 60 BP (Pta-9422).

EVENT 5

The earliest event consisted of a series of contemporary strata and lenses deposited to form a mound between 140 and 240 cm below datum. Ceramics associated with the early first millennium AD dominate in this event. The bottom-most

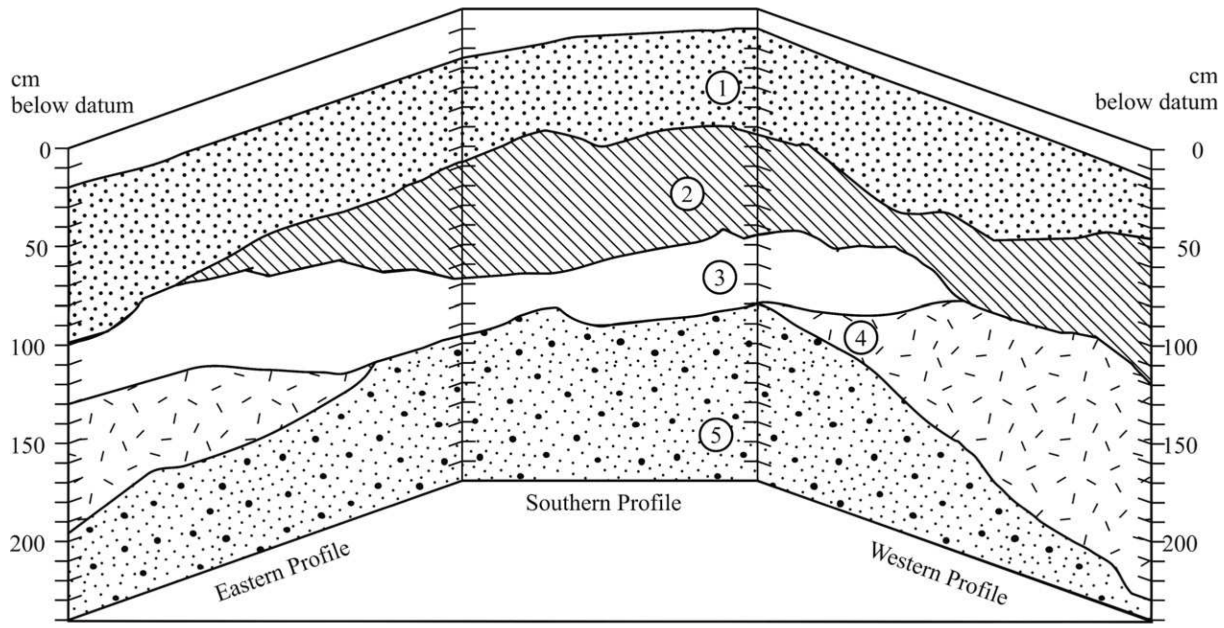

FIG. 6. *The southern, eastern and western profiles of BAL03 in axonometric projection, with 1–5 indicating separate production events visible as mound-like strata.*

stratigraphic layer in this event was one of blackish dark brown clay with a high quantity of charcoal inclusions, which rested on schist bedrock. Charcoal from this layer dates to 1990 ± 50 BP (Pta-9349). This bottom level was very moist – being on the same level as the swamp – and water seeped in from the sides of the cutting as excavations proceeded. The permanent waterlogged state of this layer resulted in extremely eroded ceramic sherds and diffused strata without clear boundaries.

SALT-PRODUCTION CERAMICS

As indicated earlier, artefacts from the salt-production areas were almost exclusively ceramic fragments. In southern African archaeology, ceramic style typologies have long been used in relative dating of sites as well as to create frameworks of cultural interaction by identifying patterns of similarity and difference (e.g. Huffman 2007).

The wide application of typologies based on stylistic criteria has resulted in a general comparability of assemblages throughout southern Africa and has been shown to be sensitive to large-scale chronological and spatial variation. Following the common method of defining stylistic types in southern Africa (Huffman 1980), I focused on shape, decoration and decoration placement as variables in a stylistic typology. As a result, it is possible to compare Baleni's ceramics to known assemblages, thereby situating it within the larger history of the northern Lowveld.

The Baleni ceramic assemblage, an essential tool in the salt-production process, also informs on the actual production chain. To this end, the Baleni ceramics are also described in a morphological typology that conveys the functional dimensions of these vessels. Here, general patterns of vessel size, decoration, presence or absence of decoration and use-alteration patterns are considered as variables that link the ceramics to the technological process of salt making.

STYLE TYPOLOGY

The typology created using attributes of ceramic vessel shape, decoration and design layout, clearly defined three chronologically distinct ceramic facies. Evers (1974), in his analysis of the Harmony and Eiland salt-production ceramics, arrived at the same three-phase classification.

The salt-production events associated with the excavation of BAL01 and BAL02 were both associated with single ceramic components (Kwale Branch ceramics and Letaba facies, respectively). In contrast, the deep stratified excavation of BAL03 contained vessels from all three facies, each associated with distinct salt-making episodes (see previous section).

KWALE BRANCH CERAMICS

The earliest evidence for salt production at Baleni is associated with farming communities from the early first millennium AD. The ceramics of these communities are commonly grouped into the Kwale Branch of the larger Urewe ceramic tradition (*cf.* Huffman 2007). Typologically, the vessels from Baleni closely resemble assemblages from early first millennium settlements elsewhere in southern Africa (e.g. Hall 1980; Maggs 1980; Meyer 1986; Klapwijk & Huffman 1996; Whitelaw & Moon 1996). Unlike most settlement sites, however, the Baleni assemblage contains only one vessel shape type, namely jars with everted rims. This is undoubtedly due to the limited range of activities associated with salt production. The only variations are found in decorations used, the most common type being bands of punctates on the rim. Less frequent are vessels that also include a spaced motif on the body (Fig. 7 and Table 1). The assemblages from Events 4 and 5 were almost identical in terms

TABLE 1. *Ceramic types from Baleni classified as Mzonjani.*

Type	*n*	Description
Mzonjani Type 1	190	Pot with everted rim and a band of decoration on the rim area.
Mzonjani Type 2	25	Pot with everted rim and a band of decoration on rim and a spaced motif on body.

of the range of vessel profiles, decorations employed and the placement of these decorations.

In southern Africa, early Kwale Branch ceramics are commonly grouped into two phases: an early Silver Leaves and later Mzonjani phase (in earlier studies both were grouped together as Matola). Typically, Silver Leaves assemblages have high proportions of vessels with bevelled facets and are decorated with horizontal incisions. Similar but slightly later assemblages, which lack the distinctive bevelled rim of Silver Leaves, are typically classified as Mzonjani phase. Mzonjani assemblages occur over a wider area than the earlier Silver Leaves and represent the expansion of farming communities over much of northeastern South Africa. The absence of bevelled jar rims from the Baleni salt workshops implies a closer association with assemblages referred to as Mzonjani, rather than Silver Leaves collections. Four vessels with bevelled rims were, however, found on a related settlement 1.5 km from the spring (Antonites 2005), which suggests that Silver Leaves ceramic users were producing salt at the site.

The Kwale Branch ceramics from Baleni were all associated with production activities at BAL01 and Events 4 and 5 at BAL 03. Two radiocarbon dates are associated with this assemblage, both from BAL 03. The first sample, taken from Event 4, dates to 1700 ± 60 BP (Pta-9422). The second sample, taken close to bedrock in Event 5, dates to 1990 ± 50 BP (Pta-9349). Both represent some of the earliest radiocarbon dates associated with farmers in southern Africa. The calibrated range of the first date, AD 251–547 (Pta-9422), falls within the lower end of the accepted temporal distribution of known Mzonjani assemblages (Fig. 8). The second date, however, is earlier than most other farming community assemblages in the South African interior. Indeed, the calibrated range of 45 BC to AD 216 (Pta-9349) overlaps with some of the earliest dates from the farming settlements University Campus and Matola IV on the southern Mozambique coast. However, it is with caution that I also consider other possibilities for the range suggested by this early date.

The most probable explanation may be that the sample is taken from old wood. As Dean (1978) notes, the death of a tree may have taken place many years before it yielded the material that became firewood. Since firewood is mainly collected as dead wood, the potential therefore exists that any radiocarbon sample from burnt wood may yield a date older than the associated human activity. The processes of wood decay before procurement and the context of wood use predominantly influence the occurrence of old wood in the archaeological record (Schiffer 1986). Several hardwood species, including mopane (*Colophospermun mopane*), red bushwillow (*Combretum apiculatum*) and leadwood (*Combretum imberbe*) occur around Baleni. Dry wood from these species are durable and preserve relatively well in the northern Lowveld's semi-arid climate (Van Wyk 1984). Thus, a vast accumulation of old wood in Baleni's surrounding environment prior to early salt production cannot be ruled out. It is probable that, since Pta-9349 is associated with the earliest phases of salt production at Baleni, the available stockpile of old wood around the spring would not have been depleted by successive salt-making episodes. If

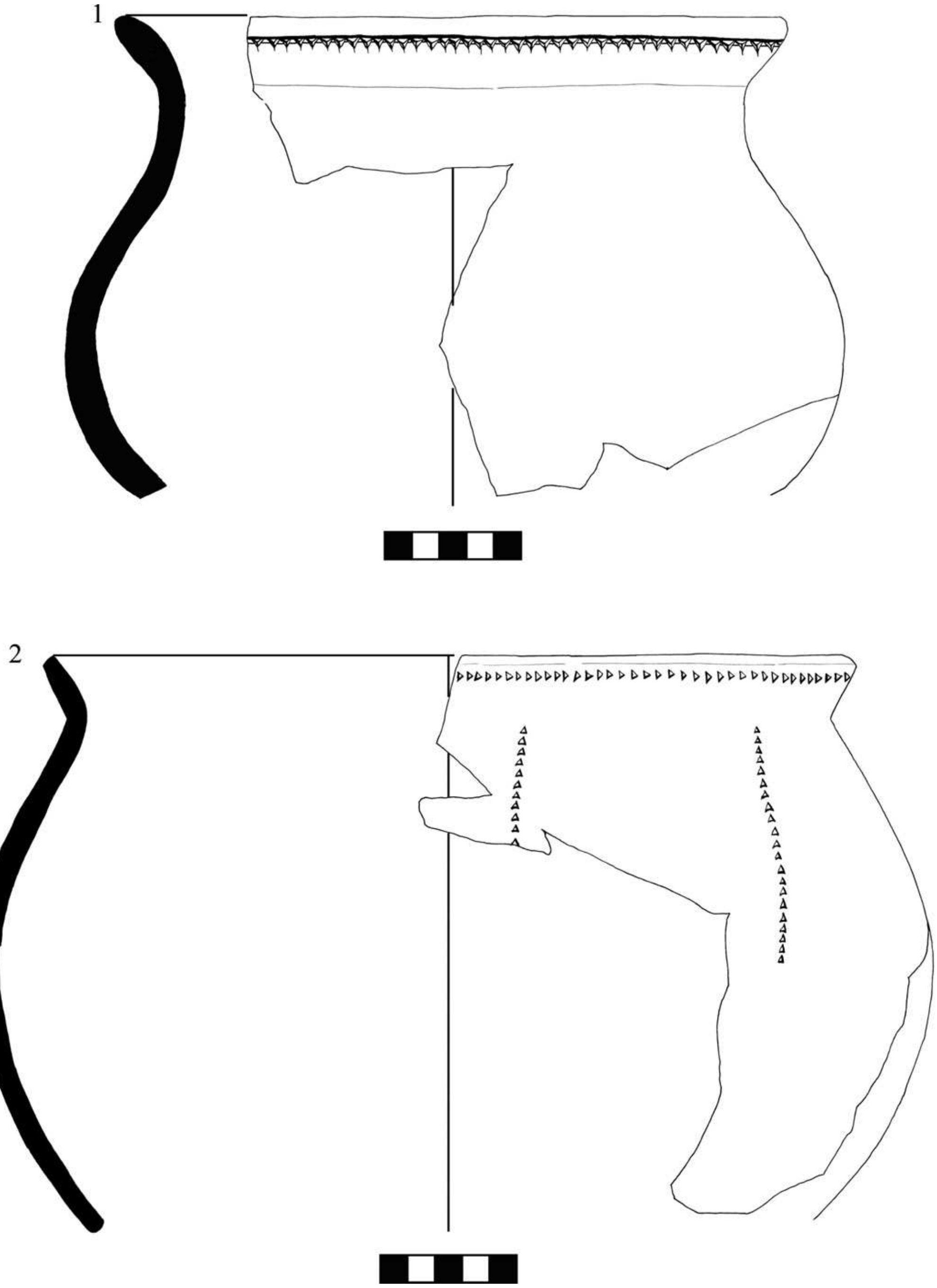

FIG. 7. *Mzonjani vessels Types 1 and 2 from Baleni.*

salt makers did use old wood, it would result in a considerable time lag between the actual salt-making activity and the absolute date of Pta-9349. An alternative explanation is that the associated sample could be from a natural event such as a veld fire, and not necessarily directly associated with the salt-production event. The sample for Pta-9349 was taken *in situ* from a clay stratum, rich in charcoal inclusions located on sterile soil. If the sample is from an older context than the salt production activity, the associated ceramic material from this level was probably trampled into the ground during later activities, or because of post-depositional movement in the mound.

The ceramics from Event 5 closely resemble known Mzonjani assemblages and do not include the characteristic bevelled profiles of Silver Leaves. It has been shown that the Silver Leaves facies precedes Mzonjani, beginning around AD 250–300. This implies that the actual date for salt-making activities associated with Event 5 probably postdates AD 400–450 – typically seen as the beginning of the Mzonjani facies. Despite the possible questions surrounding the early date, the ceramic data bear out the fact that salt production was an activity practised by some of the first farming communities in southern Africa.

EILAND CERAMICS

In northeastern South Africa, assemblages dominated by necked jars decorated with finely executed herringbone and arcade motifs, cross hatching and graphite and ochre burnish, are typically labelled as Eiland (Evers 1981; Evers & Van der Merwe 1987; Klapwijk & Evers 1987; Loubser 1991). A Lowveld expression of Eiland, known as Kgopolwe, has been defined from excavations at Phalaborwa (Evers & Van der Merwe 1987). Kgopolwe shares with Eiland the same jar and bowl shapes, single and multiple bands of decoration and rows of triangles, but lacks the predominant grouped bands and arcades. Al-

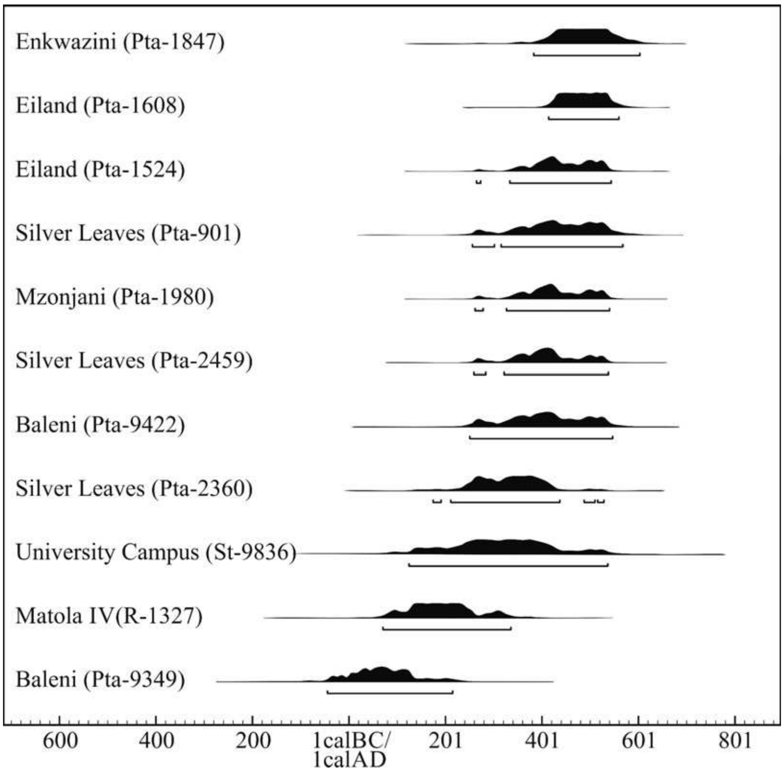

FIG. 8. *Radiocarbon date ranges associated with Mzonjani ceramic assemblages. OxCal v4.1.7 Bronk Ramsey (2010); r:5 SHCal04 southern hemisphere atmospheric curve (McCormac* et al. *2004).*

though the ceramics from Baleni clearly exhibit characteristics of the Eiland style (the predominance of necked jar types and herringbone decorations) it contains an insufficient number of vessels to confidently ascribe it to either the Eiland or Kgopolwe facies (Fig. 9; see also Table 2). Communities that decorated their ceramics in the Eiland style have long been associated with salt production: the Eiland Type site is itself a salt production site, approximately 80 km south of Baleni. Here Evers (1981) defined a middle horizon of salt production around the eleventh to thirteenth century based exclusively on these ceramics. Very few settlements directly associated with Eiland ceramics have been found in the Lowveld – instead they mostly occur west of the escarpment. This led Evers and Van der Merwe (1987) to hypothesise that ceramic assemblages from Eiland may reflect salt production treks by non-local communities. XRF analyses further provide some support for the presence of multiple non-local producer communities (Jacobson 2005). However, more detailed sourcing studies are needed to more accurately link producer communities to salt production sites in the Lowveld.

Only Event 3 of BAL03 was clearly associated with Eiland/Kgopolwe material. A single date from this production episode, Pta-9341 (520 ± 50 BP), gives a calibrated range between AD 1326 and AD 1609 (Fig. 10). Elsewhere, Eiland assemblages are firmly dated to between the 11th and 13th centuries (Evers & Van der Merwe 1987; Klapwijk & Evers 1987). The Baleni date therefore suggests that some communities using Eiland-like ceramics may have occupied the region, at least into the 14th century AD. This is the case for southern Botswana where Broadhurst style ceramics, as a late expression of the Eiland style, are dated to the 14th century (Denbow 1981). A second explanation for this late date is that it could be due to the contamination of the sample by the Letaba events above it. This is not unexpected for a site where high impact activities such as salt production occur. However, a conclusive statement in this regard is dependent on additional, securely dated contexts.

LETABA CERAMICS

Letaba-style ceramics characterise the most recent production activities at Baleni (Fig. 11). Letaba vessels were excavated in all levels of BAL02 and in Events 1 and 2 at BAL03. Two radiocarbon dates, 310 ± 45 BP (Pta-9340) and 270 ± 45 BP (Pta-9351), were obtained from Event 1 and Event 2, respectively. The calibrated ranges for Pta-9340 (cal. AD 1488–1798) and Pta-9351 (cal. AD 1502–1950) largely overlap and suggest that both these production events took place after the 16th century (Fig. 12). Since these dates fall within the last 300 years (when levels of

TABLE 2. *Ceramic types from Baleni classified as Eiland.*

Vessel type	*n*	Description
Eiland Type 1	1	Necked jar with a single band of hatching against rim and a band of bordered crosshatching on shoulder.
Eiland Type 2	1	Necked jar with a single band of bordered hatching on shoulder.
Eiland Type 3	2	Necked jar with multiple grouped bands of herringbone against rim.
Eiland Type 4	1	Necked jar with arcades filled with herringbone on shoulder, and graphite above the arcade.
Eiland Type 5	1	Necked jar with multiple grouped bands of hatching against rim.
Eiland Type 6	1	Spherical profile with band of herringbone on shoulder.
Eiland Type 7	1	Vessel of undetermined shape decorated with band of spaced counter hatched triangles.

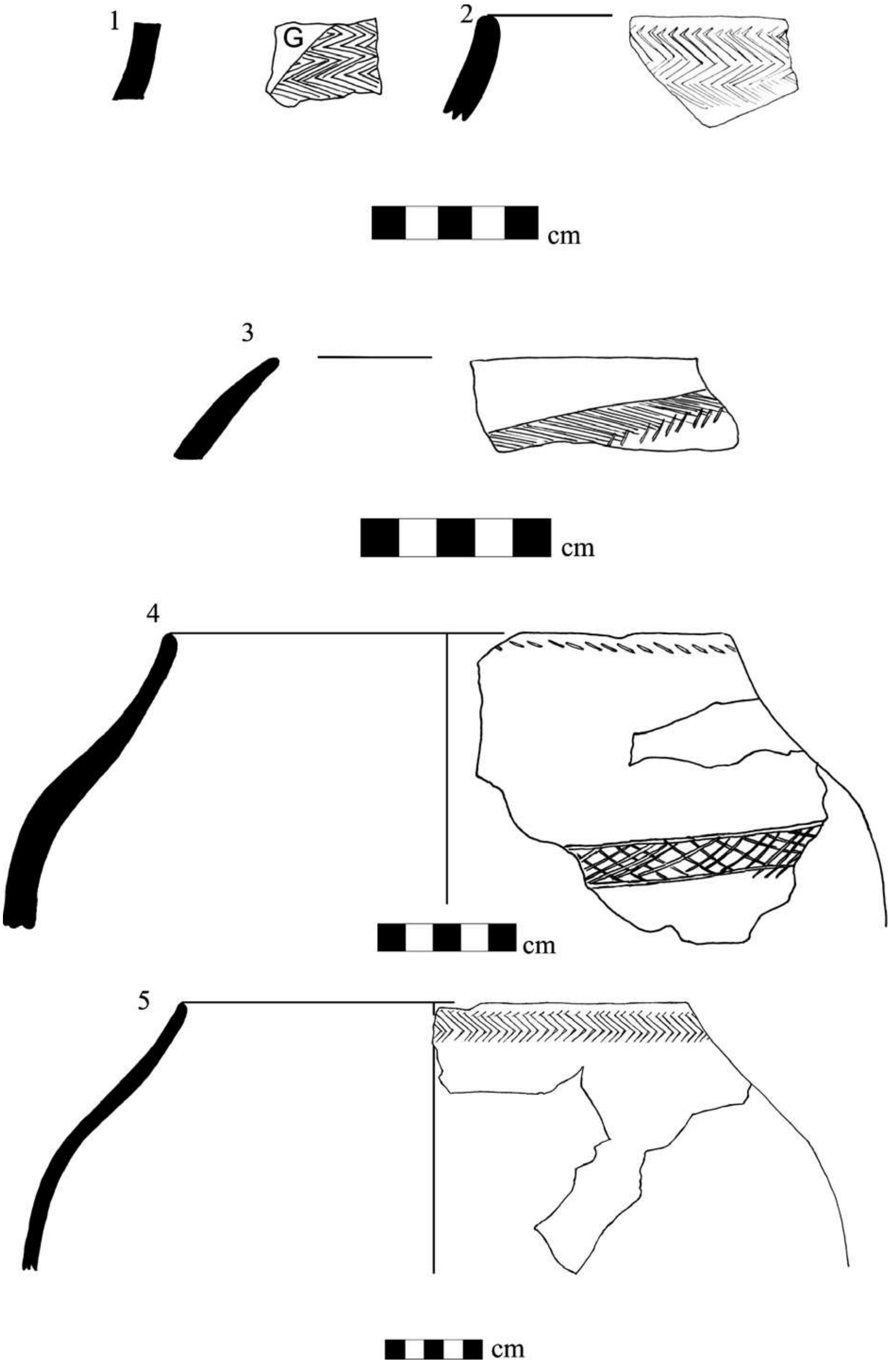

FIG. 9. *Examples of Eiland ceramics from Baleni.* (**1**) *Eiland Type 4;* (**2**) *Eiland Type 2;* (**3**) *Eiland Type 6;* (**4**) *Eiland Type 1;* (**5**) *Eiland Type 2. G = graphite.*

atmospheric Carbon 14 became diluted due to large-scale burning of fossil fuels, or the so-called Suess effect), a more precise determination of the age of salt making in these events is problematic. The overlap between the two dates, however, fits with the stratigraphic evidence, which suggests that the activities that produced Events 1 and 2, took place in relatively quick succession. The Letaba assemblage contained 41 vessels distributed in three types (Table 3).

VESSELS AS SALT-MAKING TOOLS

Because of the significant differences in the numbers of vessels from the various periods, it is impossible to make direct comparisons between each phase. However, at the site assemblage level, some general observations can be made regarding the character of salt-production vessels. Sooting patterns in salt-production assemblages were analysed to establish whether fire induced evaporation of brine was used rather than methods of solar evaporation or the collection of unrefined saline crust.

Elsewhere, sooting patterns have been used to inform on the position of a vessel in relation to the fire (Hally 1983, 1986; Skibo 1992). Unfortunately, the Baleni assemblage was too fragmented to establish on which part of the vessel soot occurred, or what the minimum number of sooted vessels were. The adopted procedure instead entailed weighing ceramic fragments with soot on the exterior as a relative indication of carbon deposition patterns in the assemblages. As seen in Table 4, sooted ceramics are present throughout all of the events from BAL03 in varying quantities, but progressively become less apparent in Events 4 and 5. This lower frequency of burnt ceramics in the lower events is undoubtedly caused by taphonomic processes. Located next to the swamp, these lower deposits were often

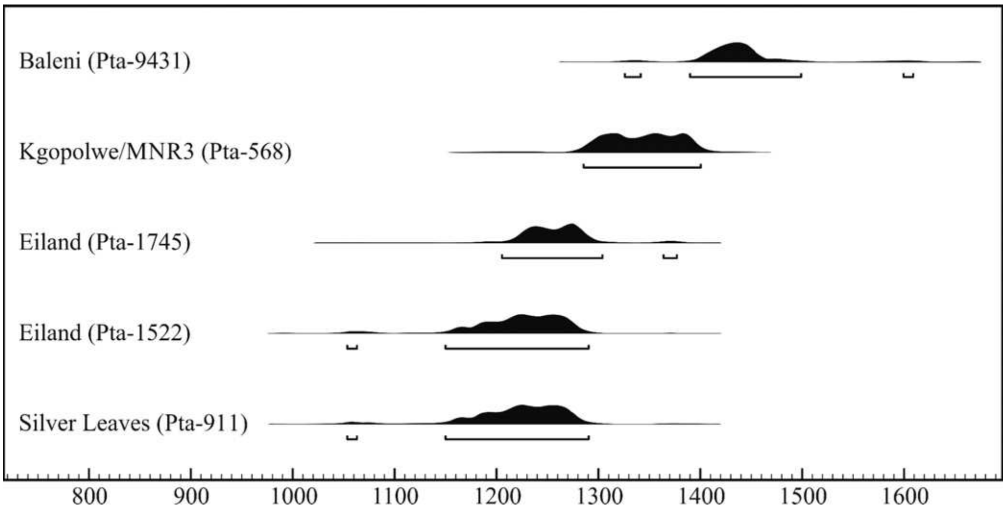

FIG. 10. *Radiocarbon date ranges associated with Eiland ceramic assemblages. OxCal v4.1.7 Bronk Ramsey (2010); r:5 SHCal04 southern hemisphere atmospheric curve (McCormac* et al. *2004).*

TABLE 3. *Ceramic types from Baleni classified as Letaba.*

Type	*n*	Description
Letaba Type 1	15	Spherical pot with either a single horizontal band of incisions, hatching or crosshatching on shoulder area, or with graphite burnishing between the decoration and rim.
Letaba Type 2	14	Spherical pot with graphite burnishing all over.
Letaba Type 3	12	Sub-spherical bowl with hatching or bordered crosshatching below rim.

waterlogged and some sherds were heavily eroded. Nevertheless, the presence of sooted ceramics does suggest that brine was reduced over an open fire in all the ceramic phases at Baleni.

The process of reducing caustic brine to crystalline salt causes erosion of a ceramic vessel's interior, visible as pitted scars (*cf.* Schiffer & Skibo 1989). Pit marks on Baleni vessels were observed without the aid of magnification. Comparison of pitting frequencies only included reconstructed and partly reconstructed vessels of which part of the vessel body was present. This was done in order to classify use-alteration on a vessel rather than sherd basis. As a result, only the Mzonjani assemblages contained enough reconstructable vessels for comparisons at this level. Large numbers of pitted sherds were, however, present in the other ceramic phases as well. The analysis shows high proportions of pitting from both BAL01 and BAL03 (Table 5). The presence of pitting therefore clearly points to the use of ceramic vessels in the collecting and boiling of brine.

DECORATED *VERSUS* UNDECORATED CERAMICS

Salt-production ceramic vessels undergo several stresses that limit their lifespan. Reducing brine over an open fire exposes vessels to heat for extended periods. In addition, the abrasive nature of brine weakens the vessel surface (Schiffer & Skibo 1989). Brine seeping through the exposed wall crystallises, leading to spalls and breaks. As a result, ceramic pots used in salt making have relatively short lifespans. This is clear at most salt-production sites, where vessels often only serve as moulds for forming salt cakes. Their preservation is of low importance, and they are often discarded after a single use (Bestwick 1975; Gouletquer 1975; Lovejoy 1986; Parsons 2001).

Despite the potentially short use-life of salt-production vessels, the Baleni data suggest little difference in the ratios of undecorated vessels within the various assemblages (Table 6). Comparisons between phases are difficult due to the extreme differences in assemblage sizes. For example, the single Eiland event is only associated with eight vessels – all of which were decorated. The more recent Letaba events typically have a larger proportion of undecorated vessels (30%), but this is no doubt due to sample size. It is therefore impossible to draw any direct conclusion on changes in the use of decorated as opposed

TABLE 4. *Sooted ceramic sherd weight from BAL03.*

Event	Sooted weight (g)	Total weight (g)	Sooted %
1	940	2755	34
2	8155	12125	67
3	1650	11460	14
4	620	8665	7
5	220	19810	1

TABLE 5. *Ratios of pitted and non-pitted vessels from Mzonjani assemblages in BAL01 and BAL03.*

Excavation	No Pitting		Pitting		Total *n*
	n	%	*n*	%	
BAL01	11	28	28	72	39
BAL03	7	24	23	76	30

TABLE 6. *Decorated and undecorated vessels per ceramic stylistic type.*

	Decorated		Undecorated		Total *n*
	n	%	*n*	%	
Letaba	35	85	6	15	41
Eiland	8	100	0	0	8
Mzonjani	150	96	6	4	154

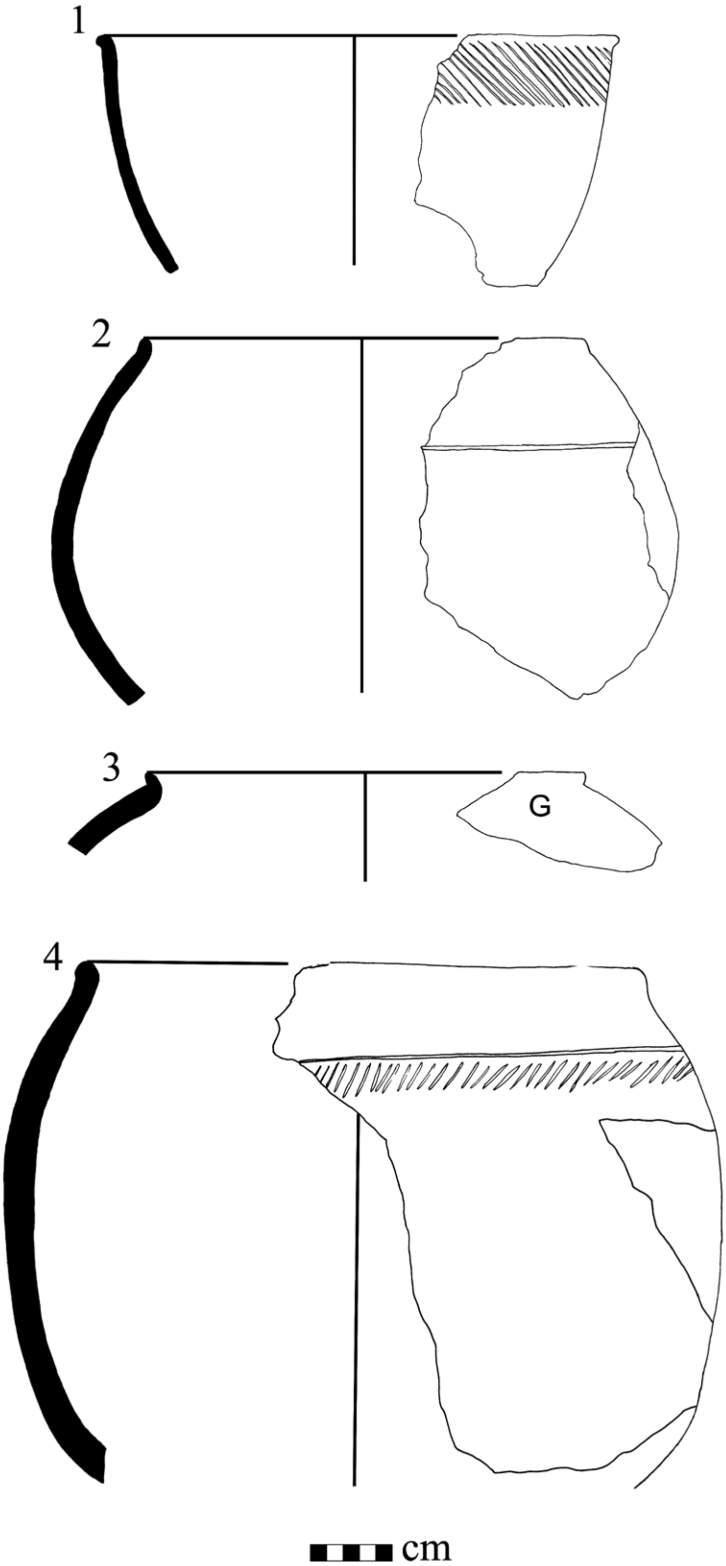

FIG. 11. *Examples of Letaba ceramics from Baleni.* (**1**) *Letaba Type 3;* (**2**) *Letaba Type 1;* (**3**) *Letaba Type 2;* (**4**) *Letaba Type 1. G = graphite*

to undecorated vessels in salt production through time. Nonetheless, the trend shown throughout the sample reflects a much higher proportion of decorated vessels with a low frequency of undecorated vessels. The production context and short lifespan of salt-production vessels clearly did not result in the adoption of undecorated ceramics or disposable salt-making vessels, as is sometimes the case elsewhere (Gouletquer 1975; Lovejoy 1986). In these cases, boiling vessels only serve as moulds for shaping hard salt cakes and are broken to remove the salt after a single use (Gouletquer 1975: 50; Lovejoy 1986: 63, 71; Parsons 2001: 214). Where boiling vessels were used more than once, some were unique to salt-making activities (Grey 1945: 468; Sutton & Roberts 1968: 57; see also Cardale-Schrimpff 1975: 84; Muller 1984: 492), while others are indistinguishable from domestic wares (Fagan & Yellen 1968: 15–16; Sutton & Roberts 1968: 53–56; Connah 1991: 490–491). At Baleni, salt-production ceramics clearly resemble those from contemporary settlements. Therefore, instead of specialised salt-production vessels, it seems that Baleni's salt producers used a familiar repertoire of household ceramic vessels.

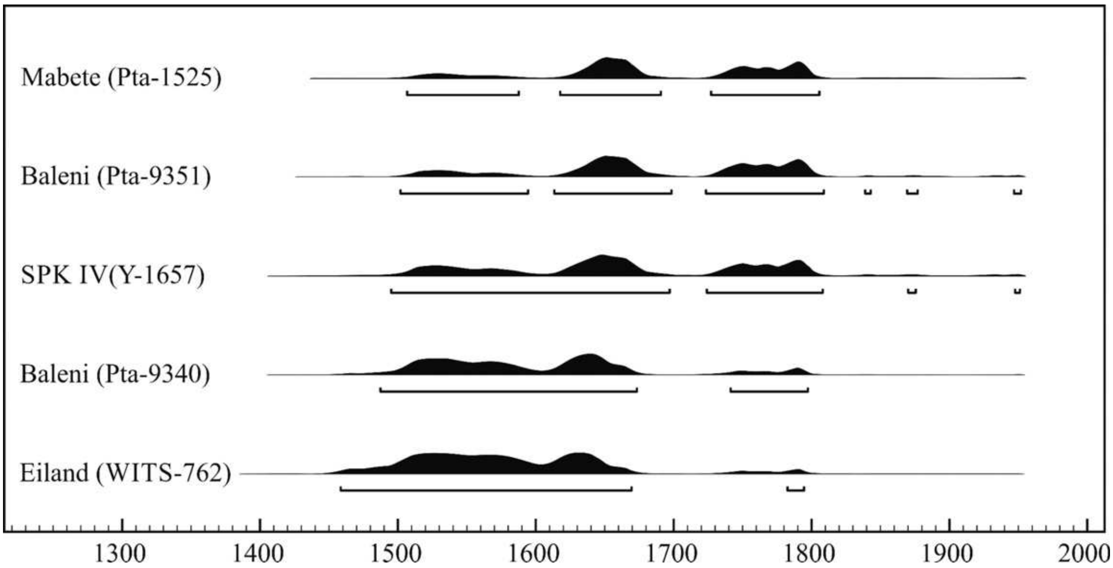

FIG. 12. *Radiocarbon date ranges associated with Letaba ceramic assemblages. OxCal v4.1.7 Bronk Ramsey (2010); r:5 SHCal04 southern hemisphere atmospheric curve (McCormac* et al. *2004).*

DISCUSSION

The paucity of material remains suggests that the activities at Baleni were probably limited to salt making and little else. Excavation of salt-production mounds revealed a very complex stratigraphy comprised of numerous pockets and lenses of ash, clay and sand, all contained within larger mound-shaped layers of sandy loam. The ethnographically observed process of mound formation offers some insight into possible processes that could result in similar stratigraphic patterns. Most of the layers from the production mounds have a sandy loam matrix, which resembles the soils around the swamp. This is probably the remnants of the salt crust mixed with coarse river sand, which modern-day salt producers use to loosen the crust and ease filtration. A similar process would account for the pockets of coarse river sand within the mounds. Additionally, the clay used to waterproof the filters probably points to the origin of clay lenses in the deposit.

The Baleni ceramics are fairly restricted in terms of variations of shape and motif and it is interesting to note that the recorded decoration motifs tend to be minimal and uniform. However, these should not be regarded as atypical, specialised salt-production tools. Instead, they resemble ordinary household vessels found in contemporary settlements throughout the region.

The salt-production process physically altered the characteristics of many vessels – eroding and pitting the interior, and eventually breaking the vessel apart. While such use-alterations are not restricted to salt making, it is the high occurrence of these marks that distinguishes the Baleni ceramics from typical domestic assemblages. Despite the high probability that salt-production ceramics will break during production, each phase contained only a few undecorated vessels. This in itself questions the potential role of ceramic style in communicating function but requires much more detailed comparison from well-contextualised ceramic assemblages from a variety of social and economic settings. Seen in isolation therefore, the ceramics used in salt production do not communicate their specific role as tools in the production process. It is only when combined with physical attributes such as use-alteration and variation at the assemblage level that these assemblages are distinct. These lines of evidence clearly suggest that salt producers used a limited range of vessel types.

At a regional scale, the excavations at Baleni mirror the Lowveld occupation sequence that Evers (1981) established from excavations at the Eiland and Harmony salt-production sites. The earliest production in the Lowveld is exclusively associated with makers of Kwale Branch ceramics who moved into the region probably around AD 200. In the southern and central Lowveld, it seems that the Goronga ceramic facies succeeds the Mzonjani facies (Meyer 1986: 248, figs 124–129; Burrett 2007). The Goronga style is still poorly defined in terms of dates, but probably ranges between the eighth and tenth centuries AD (Burrett 2007; Huffman 2007: 131). To date, no evidence for Goronga ceramics have been found on any of the salt-production sites in the northern Lowveld. Its absence at salt production sites here may suggest either a relatively low population during the end of the first millennium AD, or only minor participation in salt-making activities. This should be explored further through more extensive sampling of Baleni and other salt-production sites.

The second phase of salt production at Baleni is associated with Eiland ceramics from the 11th to 14th century. Again there seems to be a hiatus of production activities until the 16th century when Letaba ceramics appear. Letaba style ceramics continue to be made into more recent times and are associated with historic inhabitants of the region (Van der Merwe & Scully 1971).

The dated events from Baleni support previous observations of a low population in the Lowveld during various periods over the last two millennia (Meyer 1986; Evers & Van der Merwe 1987; Plug 1988). The Lowveld has always been environmentally marginal with a relatively dry climate and endemic diseases affecting both humans and domestic stock. The most important of these are malaria, nagana (carried by the tse-tse fly [*Glosina* sp.]), malignant catarrhal fever, foot-and-mouth disease, as well as various tick-borne diseases. In the more recent past these factors have played an important role in shaping settlement patterns in the Lowveld (Fuller 1923; Dicke 1932, 1937; Plug & Pistorius 1999), and it is possible that it may have played a significant role in the observed absence of permanent occupation for periods in the archaeological record.

The environmental marginality does not, however, rule out social and political factors that may have shaped human occupation of the northern Lowveld. For example, the well-documented series of violent raids by Gaza armies during the mid-nineteenth century depopulated most of the northern Lowveld (Junod 1905; Newitt 1995). The absence of salt making for specific periods does not dismiss the presence of human occupation in this region altogether. In southern Africa, past farming communities often have long occupation histories in regions today considered environmentally marginal (e.g. Ekblom 2004; Manyanga 2007). What the data do suggest, however, is that human settlement and the associated production of resources such as salt were fluid and undulating through time. Future research will potentially link similar changes in the organisation of production at other locales, to a long-term regional history of northeastern South Africa.

CONCLUSION

Farming communities were periodically extracting salt at Baleni for almost 2000 years. The results from the excavations and ceramic analysis suggest that salt production probably took place along similar lines to that described in ethnographic sources.

The patterns of carbon deposition and pitting on ceramic vessels would further suggest a comparable process of reducing brine to salt crystals in ceramic containers (*cf.* Witt 1966; Connah 1991; Terblanche 1994). However, the salt-production contexts of these vessels are not reflected in their general stylistic attributes. Neither the characteristics of shape, decoration and decorative layout, nor the types formed by the combination of these, could indicate the use of any specialised or unique ceramic vessels. Instead, it seems that salt production was an activity that required little investment in specialised tools, and as such, could easily form an extension of normal household production activities.

Despite the long history of episodic extraction at Baleni, the technological aspects of the process seem to have been fairly consistent, bespeaking a relatively simple but effective technique. However, it would be a mistake to view this as reflecting an unchanging intensity of production output – a parameter that is notoriously difficult to determine in archaeology (Muller 1984). The uncomplicated technique of salt production means that very differently organised political economic strategies would result in deposits that are very similar in content, and may differ mainly in scale. Charting the cycles of production through time will be the next step in research at Baleni.

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NOTES

[1]Evers (1974: 68) reported date RL-206 without error ranges. Subsequent searches for the original date proved unsuccessful since the laboratory (Radiocarbon Ltd.) no longer operates. In addition, none of the date-lists in the *Radiocarbon* journal report the date either.

[2]All dates were calibrated to the southern hemisphere atmospheric curve (McCormac *et al*. 2004) using the OxCal v4.1.7 software programme (Bronk Ramsey 2012).

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