

■ ZIMBABWE

Guyo and huyo: science proves the stone tools used in liberating gold fines from waste in Nyanga district, Zimbabwe

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Gold Dust in Stone Hollows

“[G]rinding hollows ... associated with metal production” is a “significant part of the archaeological record” that should be “brought to the attention of archaeologists” says Swan (1996: 80), introducing reports from modern miners of gold detected in hollows manually worn in stone. Her information includes Kritzinger’s examination (Burchett in Swan 1996: 75) of “grinding hollows through a magnifying glass” on a rock outcrop in the southern region of Zimbabwe’s central plateau, recorded in site report 1928:DD:6 Archaeological Survey of Zimbabwe 1964, Museum of Human Sciences. Resuming this research after recently retiring from the business world, Kritzinger has brought Swan’s “mineral milling sites” back into focus – this time in the eastern highlands of Zimbabwe, and tested more scientifically than the experiments on “pestles or hammerstones ... swilled in a pan ... [giving] a fine concentrate of gold” recounted by Swan (1996: 75).

Figure 1 features the auriferous greenstone belts of the central plateau on which Swan (1996: 79) maps metal-milling sites where “precolonial mines were probably worked between the end of the first millennium AD and the beginning of the

nineteenth century ... until European settlers began to rework the old mines from 1890 onwards” (Swan 1996: 75). The efficient mining and exploration of the “so-called Ancients ... resulting in discovery of nearly all outcropping gold, iron and copper ore deposits” is applauded by Forbes Mugumbate (2010: 28), deputy director of Zimbabwe Geological Survey. Regretting that “exploration in the last 100 years has been mostly biased at rediscovering the Ancients’ mines,”. Mugumbate (2010: 30) points out that “[t]he vast areas of granite and gneiss [away from the central plateau]... are generally considered less important in terms of mineral potential, and thus have largely not been geologically mapped and scientifically explored.”

Apart from Stocklmayer’s (1980: 139, 144) instance of “the discovery in 1934 of ancient workings in the Inyanga North ... *granite terrain* [his emphasis]” which “sparked off a miniature ‘gold rush’,” the granitoid expanse of Nyanga is one of Mugumbate’s commercially under-explored regions. Near the eastern border of Zimbabwe – left blank on Swan’s map of precolonial metal-milling sites – it is the area of Kritzinger’s research (Figure 1). In an open letter of 13 April 2012 regarding the Nyanga research results featured in this paper, Mugumbate concludes: “[a]ssociation with [Kritzinger’s] project will therefore enable the Geological Survey to re-visit the geology and mineral potential of this area that has largely been overlooked ... [it] shares similarities with that of the Chimanimani area ... where a new mineral province has been discovered” (Figure 1).

In the eastern mountains of Nyanga there are few outcropping ore-bodies, and no effortless prospecting like targeting the precolonial surface workings and deep-rock shafts of the central plateau. Nyanga’s “steep and rocky hills with thin erodible soils” (Sutton 1983: 13) are believed by archaeologists to have been chosen for cultivation in preference to “valley[s] between covered with thick reddish colluvial soils” (Sutton 1983: 17). But the mining engineer Telford Edwards, albeit supposing that mysterious “ancient terraces [“formed of ...



Figure 1: Map of Zimbabwe showing the auriferous greenstone belts of the central plateau. The rectangle represents the Nyanga terraced region predominantly granitic mountains of Manicaland, where Swan (1996:79) records no metal-milling sites. In contradiction, clan and place names tally with 20 gold-mining locations of historical Manyika (Kritzinger 2012b).

boulders and stones”] ... [were] for the purposes of cultivating corn,” reported in a letter to the national newspaper *The Herald* on 20 December 1898 that some of the “astonishing abundance” of terraces “owed their existence unmistakably to washing the ground for alluvial gold. Large quantities of quartz debris are everywhere observable and also old ground sluices.”

Payshoots Beneath Terraced Ground

There is no archaeological evidence that “homestead occupation extended beyond a single generation” (Soper 2002: 133), and “very hard to see historical support for the idea of a larger population” (Beach in Soper 2002: 233). “The paucity of finds” (Summers 1958: 241) does not endorse Edwards’ concept of a “teeming population” sustained by terrace farming. But, significantly, profusion of quartz rubble is a prospecting clue in Zimbabwe: these “stray fragments that are here called ‘float’,” are weathered (Figure 2) from “[quartz] veinstone

... [which is] a necessary antecedent to the finding of gold” (Mennell 1934: 15,14). Sampling such quartz heaps (Figure 3h) led two of a growing band of *makorokoza*, illegally panning rivers flowing from Nyanga’s terraced hills, to register ten gold claims in 2005. This gold mine is targeting stockworks of narrow auriferous quartz veins buried beneath artificial terracing. It is the southernmost of four new prospects across a 90km straight-line distance (Figure 1), including renewed interest in the shortlived 1930s exploration.

The regular position of hillslope terracing on rocky slopes and steep scarps is a curious choice for farming in a virgin land. This is the zone of easily extracted secondary enrichment commonly deposited on hillslopes by weathering of a primary source (Figure 2) such as quartz reefs, veins and stringers. “Quartz is the principal host of free gold in Zimbabwe” (Swan 1996: 77). Its appearance on terraces is repeated in and around the numerous stone-lined tanks associated with them. Previously

unremarked as dual performance, it cues ‘pay dirt’ exploited from the former as ‘feed’ for the latter.

In contradiction to Soper’s (2011: 65) objection to the “restricted size [??] and circular shape of the ‘tank’” for bulk washing – the tanks are hydraulically engineered in a manner suggesting gravity concentration of a heavy metal (Kritzinger 2010: 11). Agricola (1556: 300-346) gives seven methods for washing heavy metals, particularly lead and tin, in slowly flowing water made turbid by stirring with long poles. Agricola’s (1556: 316) “large settling-pit ... eight feet [2.4m] in length, breadth and depth” dedicated to gold recovery is not far removed from average dimensions of the Nyanga tanks (Kritzinger 2010: 11).

The tanks are in fact eminently suited to an ore-classification method to reduce bulk before “the gravel could then have been removed and panned leaving [in the pan] the usual concentrate containing gold” (Harding 2012: 8). Called ‘hindered settling’, it is shown in the sketch based on information from Richard Dollar, mining geologist and longterm gold miner in Zimbabwe (Figure 3). Being roughly circular, the platform walls are robust enough to withstand the hydraulic pressure of water, “preferably entering from the bottom to lift the content and start the sorting process” (Dollar, personal communication). This could explain the unusual floor-level point of entry of a tunnel into a tank if used as a flume – considering the normal filling point would be from the top.

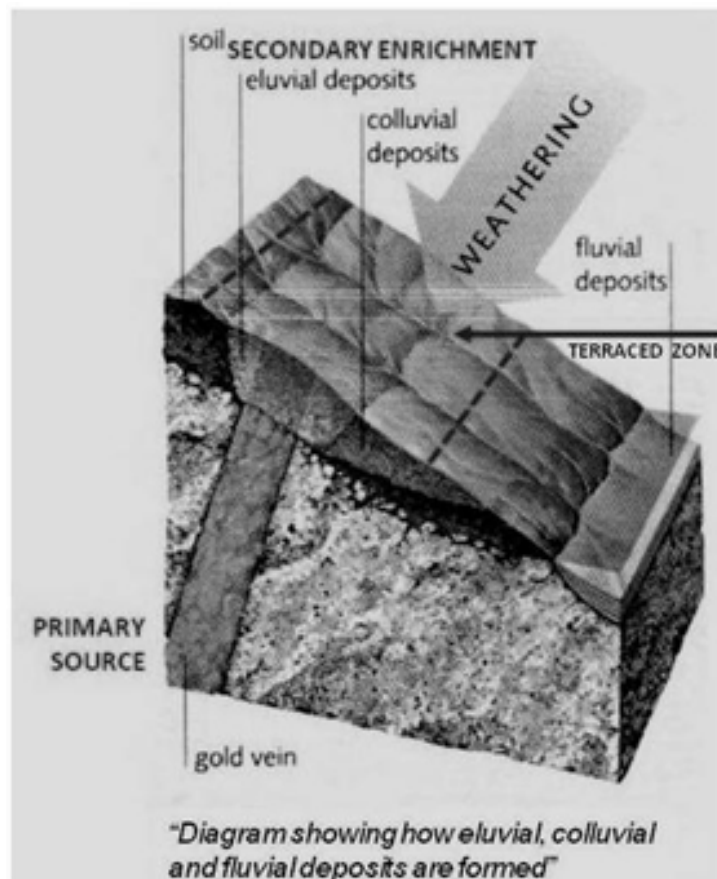


Figure 2: Genesis of gold (© British Natural History Museum). The altitude of Nyanga terracing (1400-1900m asl) corresponds to the elevation of easily exploited secondary enrichment weathered on hillslopes between primary gold sources (unexploited in precolonial Nyanga) and fluvial gold (currently extracted from gravel banks).

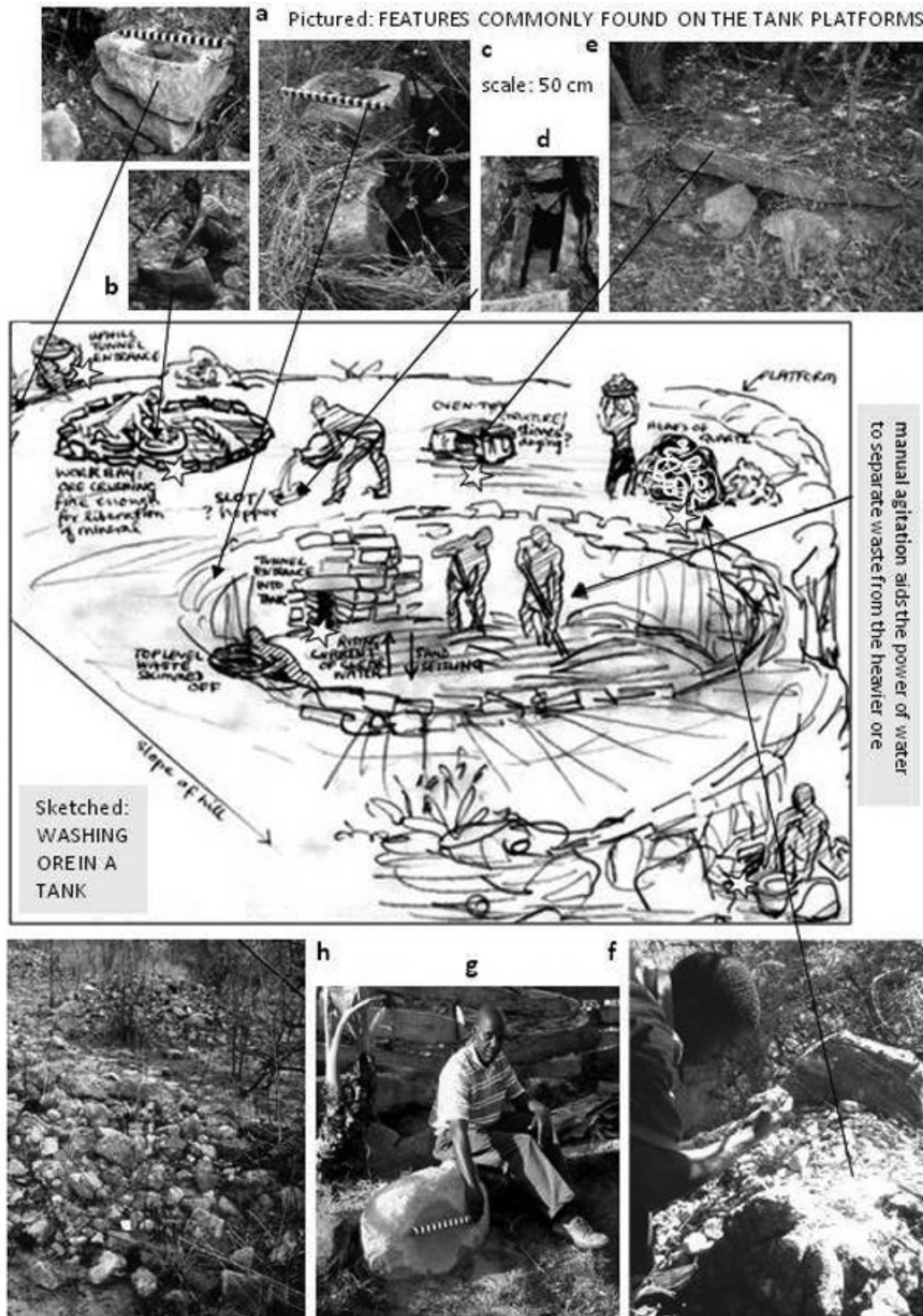


Figure 3: Concept of gold-recovery from a stone-lined tank typical of hundreds built into freestanding platforms in the Nyanga hills. Stars show where samples from tunnels, drains quartz heaps, and ‘ovens’ assayed with values of residual gold.

a, b, c, g: large grindstones; a) and c) found at the same tank, at tunnel uphill entrance and on wall respectively; d: standardized slot, approximately 16x25cm (shown outside workbay for clarity); e: oven-type feature showing stone slab with “one edge chipped to a curve” (Soper 2002: 212) over natural draught hole; f: stone container holding stockpile of gold-bearing quartz (Table 1); g: heavy-duty grindstones; h: typical heaps of sorted quartz.

Split-level Floors

It is an observable fact that the sloping tunnels were launders accessing water from hilltop runoff or via stone-lined furrows tapping distant springs or streams (Kritzinger 2010: 14). In the first stage of the classification option illustrated in Figure 3, the drains could be blocked with the large stones often found where they exit into the platforms (e.g., Soper 2002: 176,178). In an ore-settling process, which could take many days, the drains when left open would carry away the tailings, a procedure signified by the gold residues assayed in drain samples (Kritzinger 2010: 14). To establish the most likely washing process employed requires a dedicated sampling program by which to create digital flowcharts.

For its entire length through a platform, commonly 7-9m, the tunnel is roofed with slabs on top of which is the largest of several work bays enclosing crushing floors. Where excavated the floors are seen to be half paved/half plastered with clay (Figure 3). One of the slabs of the tunnel roof has a standardised slot (Figure 3d) positioned in the paved half in Soper's excavated floors (Soper 2002: 176, 182; *see also* Summers 1958: 65). University of Zimbabwe lecturer Kudzai Musiwa sees the slot as a launder to control the flow of water, coincidentally in agreement with the "slit" of Richards et al. (1925: 95) by which "water in falling from a height of 12 inches [30cm] or more exerts a considerable washing force," and the "[gold] particles ... washed down into the settling-pit or trough, by a stronger current of water ... through a small launder" of Agricola (1556: 333).

Other archaeological features demonstrate the type of work in progress on the platforms: more work bays enclosing crushing floors, stockpiles of quartz (Figure 3f), a remarkable profusion of grindstones (*makuyo*, Figure 3a, b, c, g) and rubbing stones (*mahuyo*), and also oven-type features (Figure 3e). South African field and mine geologist Anthony Harding (2012: 7) finds "[t]he general

form of ... [the] hydraulic tanks ... especially when illustrated by means of the diagrammatic cross-section [Kritzinger 2012a: 6] have one word written all over them – mining! This interpretation makes more sense than their being posed as agricultural bins or cattle kraals."

Infectious Micro-organisms and Flies

The latter interpretation – Soper's (2011: 61) "previously accepted agriculture/settlement site hypothesis" inferring that the population was crammed on the platforms with dwarf-sized cattle in the tanks – is currently disputed by National Museums and Monuments of Zimbabwe's chief archaeologist who points out that "in the Nyanga high-rainfall area the cattle would be flooded in those deep pits and pit-penning would be contra good-animal-husbandry practice" (Chipunza 2012: ix). Zimbabwe entomologist Dr. Glyn Vale is in agreement: "the conditions there ["a damp, poorly ventilated and dark hole"] seem especially designed to promote foot-rot," an infection from micro-organisms cautioned against at a "course on livestock production at Oxford" (Vale, personal communication).

Chipunza and Vale's 'flooding' is presupposed by the fact that the tunnel always enters the tank from upslope. A design fault in cattle management that is not employed in modern Zimbabwe: traditional log-constructed cattle pens always have the animals' entrance at the downhill end in line with Turnbull's rule (in Kritzinger 2008: 3) that "[t]he gate should not be at the highest point, otherwise it becomes a channel through which water runs into the kraal." Local farmers have another practical objection to cattle kept in tanks which British archaeologists have not considered in their interpretations of the platforms for "occupation homesteads" (Soper 2011: 64) or "compounds" (Sutton 2010: 63): ticks and flies.

Traditional milking is done in the open air. To escape the certainty of flies in the manure

of “deep pits” or “dark holes”, “agriculture/settlement site” theorists would have to see their dwarf cows, not stall-fed, but moving in and out daily for milking. In 1896 Sykes (1972: 268) witnessed how an encampment of Matabele, hiding a few cattle from British colonial forces in southern Zimbabwe, made them “bend their knees, so they [could] crawl through” ... “a small hole” in the rock stronghold of Kanone. Arguably the cattle were stolen from the indigenous Mashona by raiding Matabele following their invasion of the country in 1837 – when it was the Mashona hiding cattle in caves. This need had ceased by 1897, but the forced entry described by Sykes would be bound to inflict grazed knees on top of foot rot if introduced in the Nyanga paved tunnels for postulated dwarf cattle.

Disregarding the earthly fact of flies, Soper applies (2002: 110) an “ideological importance” to explain “the relative elevation of the house[s] above the cattle in the pit,” and designates the rings of stones on the platforms as hut circles, the many grinding tools left on their floors evoking preparation of millet under a postulated “thatched roof, supported on the stone [ring] wall” (Soper 2002: 108) – under which there would be the greatest nuisance of flies. But he finds it puzzling “why such a large proportion of the available homestead space should have been devoted to this particular activity [grain grinding]” (Soper 2002: 109). Summers (1958: 82) however found that at structures with paved/plastered floors “the work was not done inside a hut but in the open air.” Today’s rural people agree with Summers (1958: 84, 85): “there is no modern counterpart, for daily grinding is done outside the hut without any particular preparation of the ground”.

Summers’ photograph (1958: Plate 18a) of a “[w]oman grinding meal” on a flat stone shows “a well-known [“saddle”] quern type ... [which] seems to have come into this country only with the nineteenth-century Nguni invaders” (Summers 1958: 148). His close-up (1958: Plate 17b) of a hollowed stone looks very like Swan’s Plate 1 (1996: 74) of a “saddle quern’ ... for grinding cereal grain.” Summers’ Plate 17b and Swan’s Plate 1 are

indistinguishable in halftone from the many portable grindstones of the hollowed type removed from three tank sites during construction of a golf course which club manager Francis Chiuta points out are too heavy for the women in his family to lift (Figure 3g). Summers (1958: 146-47) maintains that the hollowed “depression ... is formed partly by pecking or battering with granite or dolerite pebbles, and partly by rubbing grain with another granite grinder ... [w]hen the lower stone becomes smooth [and] grains of millet tend to roll.”

Proving the Role of the *Guyo* and *Huyo*

Graduating from guesswork to the laboratory to validate their function, samples were taken from the soil and/or quartz chippings around portable grindstones on or near platforms. Choice of samples was limited by the number of *makuyo* that had been taken away for use as urban birdbaths or rural chicken-feed troughs, and restricted to remaining examples that were either half-buried or were still *in situ*. The resulting information (Table 1) complements the tunnel and drain samples (Kritzing 2010: 14) which Harding (2012: 7) considers “certainly warrant further attention and follow-up work ... these values are above what one would expect from a general background value in the areas tested.”

Table 1 present laboratory results that reveal that the stone equipment called *guyo* and *huyo* was employed in the dressing of ore to release gold. Their marked presence on or adjacent to the tank platforms exhibits their role in an age-old sequence described by Pliny the Elder for the recovery of gold in the first century A.D.: “when they have dug out the ore, they crush it and wash it and burn it and reduce it to powder.” Pliny’s inclusion of burning which increases the friability of quartz would assist in reducing “the ore to as fine a powder as possible [to] facilitate efficient separation of the gold” (Swan 1996: 77). This might explain the presence of oven-type features on or near platforms (Figure 3e), for which residual values of 0.08-0.27 g/t Au have been recorded by fire-assay from three plat-

form examples tested 9km from each other, and a fourth of 0.04 g/t Au within the walls of a hilltop ‘fort’ above the three tank sites sampled at Tizai and Chiwai (results of 0.05-0.96 g/t Au from their tunnels listed in Kritzinger 2010: 14).

A sequence slightly different to Pliny’s given by South African mining engineer Geoff Park (personal communication) suggests another reason for ‘ovens’: “[after] manual removal of the upgraded product from the tanks [it is] followed by further drying, manual crushing and grinding and finally panning ... based on what I read in the Ore Dressing book [Richards *et al.* 1925], my recollection of the tank structures, and hopefully some common sense.” A “drying” stage might explain a claylike substance daubed on top of many ‘ovens’ as industrial slimes rather than insulation for a reverberatory method of heating quartz.

Ore-milling on Flat Rocks

Values of gold assayed in grab-sampling the perimeters of rock outcrops having their surface worn into hollows by attrition (Figure 4) define them as sites of manual milling to liberate gold from quartz waste (Table 1). Kritzinger’s presentation to Summers of findings from the ore-milling site recorded in archive report 1928:DD:6 (see page 1) assisted him to recognize outcrops marked with hollows as ore-milling sites:

“As a result of the crushing both the fixed stone and the moving one would show the wear which you have described. Although I was sceptical at first I am now convinced that this is a discovery of considerable importance in determining the methods used in extracting gold in pre-European times” (Summers, personal communication).

coordinates	height	location	sample	lab*	assay	description
UTM 36K E/N	metres	local name	from		result	
					Au (g/t)	
0457600/7975400	1535	Mateta Rd W2	Guyo Fig 3: a	ZL	2.04	at tunnel entrance
0458872/7970430	1917	Samanyanga N	Guyo	DME(i)	4.00	near platform
0457665/7975521	1547	Mateta Rd E2	Guyo	ZL	0.07	on platform
0465700/7993020	1500	Ziwa Rd E1	Guyo	ZL	0.13	on platform
0461482/7971893	1801	York Forest S2	Quartz heap	ZL	0.54	near platform
0457928/7976465	1558	Mateta Rd N1	Quartz heap	ZL	1.01	on platform Fig 3: f
0457759/7975408	1528	Mateta Rd E	Quartz heaps	ZL	0.07	near 8 tanks
0461052/7971997	1788	nr Derry 4	Quartz heap	ZL	0.08	on platform
0460700/7980750	1480	Mhokhore	Quartz heaps	ZL	0.46	near 5 tanks
0457761/7976669	1551	Nyadenji Hill	Quartz rubble	DME(ii)	3.24	commercial exploration
0451323/7995967	1322	Ruchera	Milling site	ZL	0.10	>100 hollows
0460400/7980200	1300	Mhokhore Hill	Milling site	ZL	1.34	<50 hollows
0467084/7994155	1556	Nyahokwe [left]	Milling site	ZL	0.12	>200 hollows Fig 4
		Nyahokwe [center]	Milling site	ZL	0.49	periphery soil (as i)
		Nyahokwe [right]	Milling site	ZL	0.17	quartz fragments

* ZL: Zimlabs, Harare (SANAS-accredited: confirms method requested: fire assay lead oxide fusion. AAS finish)
 DME: Dept Metallurgical Engineering i) sampler Toga, senior lecturer ii) sampler Djorvic, exploration geologist

Table 1: Ore-dressing. Grab sample results from portable grindstones (*guyo*), quartz stockpiles, and *in situ* rock outcrop milling sites across a straight-line distance of 22km.



Figure 4: Large rock outcrop worn into hundreds of hollows by manual attrition. Gold values assayed in samples taken from three sections of the circumference (Table 1 i-iii). Catchments for rain water, these descending hollows are probably what Telford reported as “old ground sluices” in Zimbabwe’s national newspaper, 1898.

Three years prior to this new awareness Summers had published Plate 17a (1958) captioned “Grinding-holes in rocks”. A decade later he selects this illustration (1969: 176, incorrectly noted as *page 17*) as an example for distinguishing between “grain-grinding places on flat rocks” and milling sites for ore, attributing to the latter “the necessity of using permanent water for concentrating the gold”. In fact his Plate 17a example of grain grinding is on the lower slopes of Mt. Hamba, only about 200m from the headwaters of a tributary of one

of Nyanga’s three major rivers, the Nyangombe. In 2004 Kritzinger was directed to a stretch of the Nyangombe less than 3km due west of Mt. Hamba by the Ziwa Museum curator to sketch families secretly catching gold on the blankets of homemade sluices. Summers’ 1958 Plate 17a site of Mt. Hamba illustrating “grain-grinding places on flat rocks” is little different from his Plate 7 photograph a decade later identified as an ore-milling site “in the living rock” near Gaika Mine (Summers 1969: 177) – subsequently one of Zimbabwe’s richest gold mines.

Five kilometres due east of Mt. Hamba is the Ziwa National Monuments tourist attraction Mt. Nyahokwe (Figure 4). Results of sampling three sections at the base of this extensive milling site (Table 1: Nyahokwe i, ii, iii) in the presence of the curator, are direct evidence that grinding auriferous ore made the innumerable hollows. It is logical to deduce that this ore was the feed for a tank just off Figure 4 top left, and several more downhill. The three milling sites spaced 18km apart at Nyahokwe, Mhokhore and Ruchera featured in Table 1, are all near but not “in close proximity to water”, a requirement however that Swan (1996: 77) finds “was not essential” for ore-milling. The fire-assay results from these sites (Table 1) are a significant advance on the information given by Summers (1969) and Swan (1996), both relying on various miners’ verbal reports of specks of gold in grinding hollows, and “traces of gold being found in the bottoms of dolly-holes” (Summers 1969: 174) – “a mining term in the nineteenth century ... for crushing gold-bearing quartz” in circular stone mortars (Swan 1996: 73) that are common in the central plateau but rare in Nyanga.

Conclusion

Mupira (in Kritzinger 2008: 18) concedes that “[p]ossibly some of the grinding grooves and stones generally seen as being for food processing could also have been used in such gold processing [in Nyanga].” The only way to be sure of the original substance pulverized in these hollows, is to expand on Kritzinger’s sampling pilot which has been restricted by self-funding to date. To fill in the blank on Swan’s map (1996: 79) for the Nyanga region (Figure 1), and to check whether Summers’ distinction between ore-milling of the central plateau and the grinding of grain he attributes to similar sites in Nyanga is correct, funding has to be found for assaying many more samples from hollow-marked rock outcrops in the Nyanga landscape.

Single-grain luminescence dating of crushed quartz buried in the tunnels, drains and tanks might give evidence of the last function of the quartz: “if

used for mining, the grains should all be the same age; if natural backdrop, one would expect a wider distribution of ages, with only the youngest grains providing information on last use” (concept notes, Dr James Feathers, Washington State University, August 2012).

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