AFCAP

Mapping Calcretes in Inhambane Province, Mozambique for Sustainable Rural Access

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1. Project Motivation

Mozambique:

- Subsistence agriculture dominates the economy
- 70% roads are unpaved and many are unreliable in the wet season

Inhambane Province:

- It is expensive to build gravel wearing course and sealed roads because naturally occurring gravels are scarce
- However calcrete does occur, but existing sources are limited and haul distances often long
- There has been no co-ordinated research to find calcrete
- **Finding additional deposits is therefore imperative**

2. Use of calcretes in road construction

- Calcretes are pedogenic materials where $CaCo_3$ precipitated out of soil water and groundwater
- Calcretes are used widely in LVRs in Southern Africa and Australia
- They usually form where annual rainfall is 100-500mm
- Most have formed during the Pliocene and Late Pleistocene
- Drainage, regional geology & topography are important factors

- There are various types of calcrete used in LVR construction as sub-base, base and w/c gravel

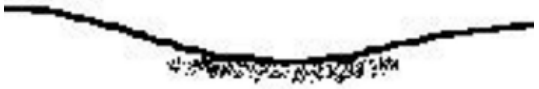
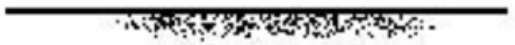
Boulder/hardpan calcrete

Nodular calcrete

Powder calcrete

3. Calcrete research in Southern Africa

Considerable research has been undertaken prospecting for calcretes, especially in Botswana and South Africa

Landform	Cross-Section
Pan with platform	 *Note: Platform is not usually as distinctive or obvious as shown here*
Pan without platform	
Depression	
Inter-dune hollow	
Valley (old river channel)	
Grey sand	

(Lawrance & Toole 1984)

4. Finding calcrete in Inhambane

1. Based on landform indicators from Botswana using remote sensing (stereo air photos and Landsat)
2. Based on the topography, vegetation and soil type at existing calcrete borrow pits using remote sensing and field observations
3. Use of calcrete probing to identify potential calcrete in areas mapped from Activity 2
4. Use of trial pit investigations to prove calcrete in Activity 3 areas
5. Extrapolation of results from Activities 1-4 to identify further areas for prospecting

Activity 1: Using indicative landforms from Botswana

- Identified pans and pan platforms occur in the eastern part of the Province where elevations and annual rainfall are highest and the effects of recent sea level change are greatest
- Probing in these locations generally failed to yield any calcrete

Activity 2: Common indicators from existing calcrete borrow pits

- Sparse, thorny vegetation, especially Camel Thorn

- Grey silty sand soils

- Low-lying subtle depressions , sometimes with <20m defining relief

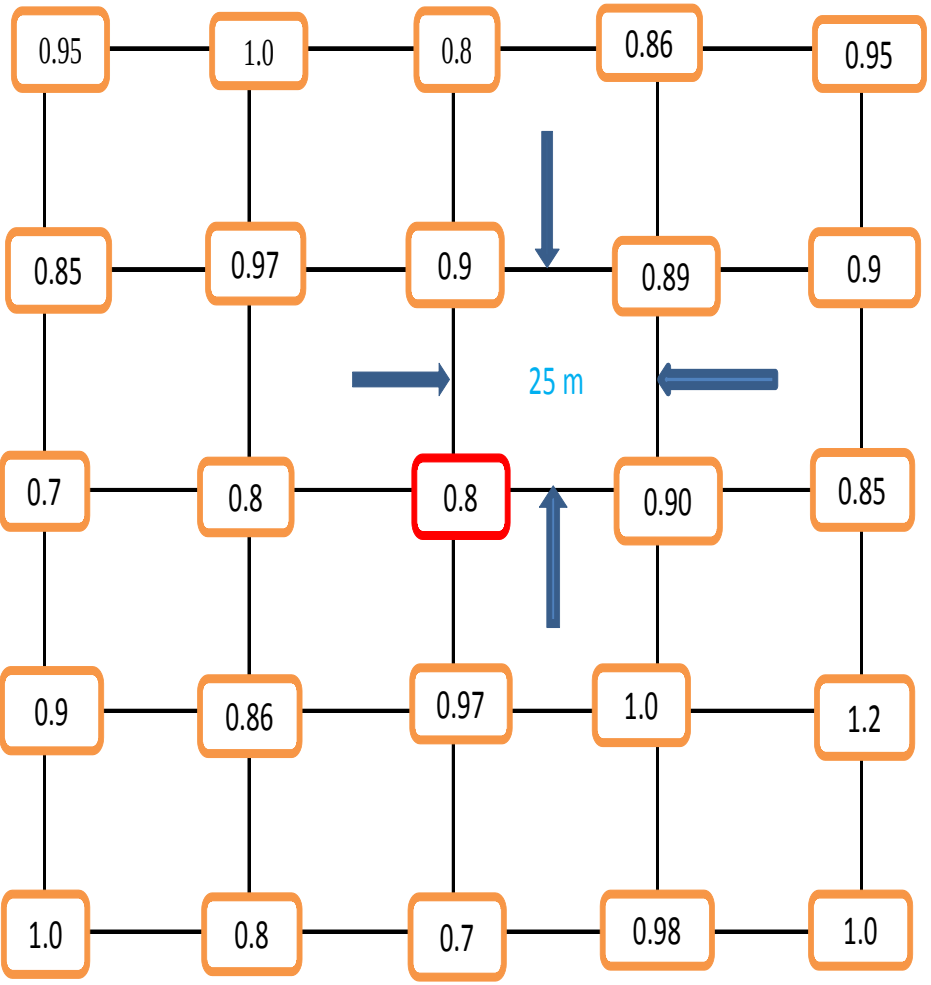
Remote sensing and field observations identified a long list of areas with the same common indicators

Activity 3: Calcrete probing in areas with the same common indicators

- The calcrete probe can penetrate ground to 1.8m
- It ‘bounces’ on hard layers and, when extracted, whitening on the rod and the tip indicates calcrete
- Effervescence upon contact with dilute hydrochloric acid confirms calcareous material

Probing identified 20 new sites of likely calcrete

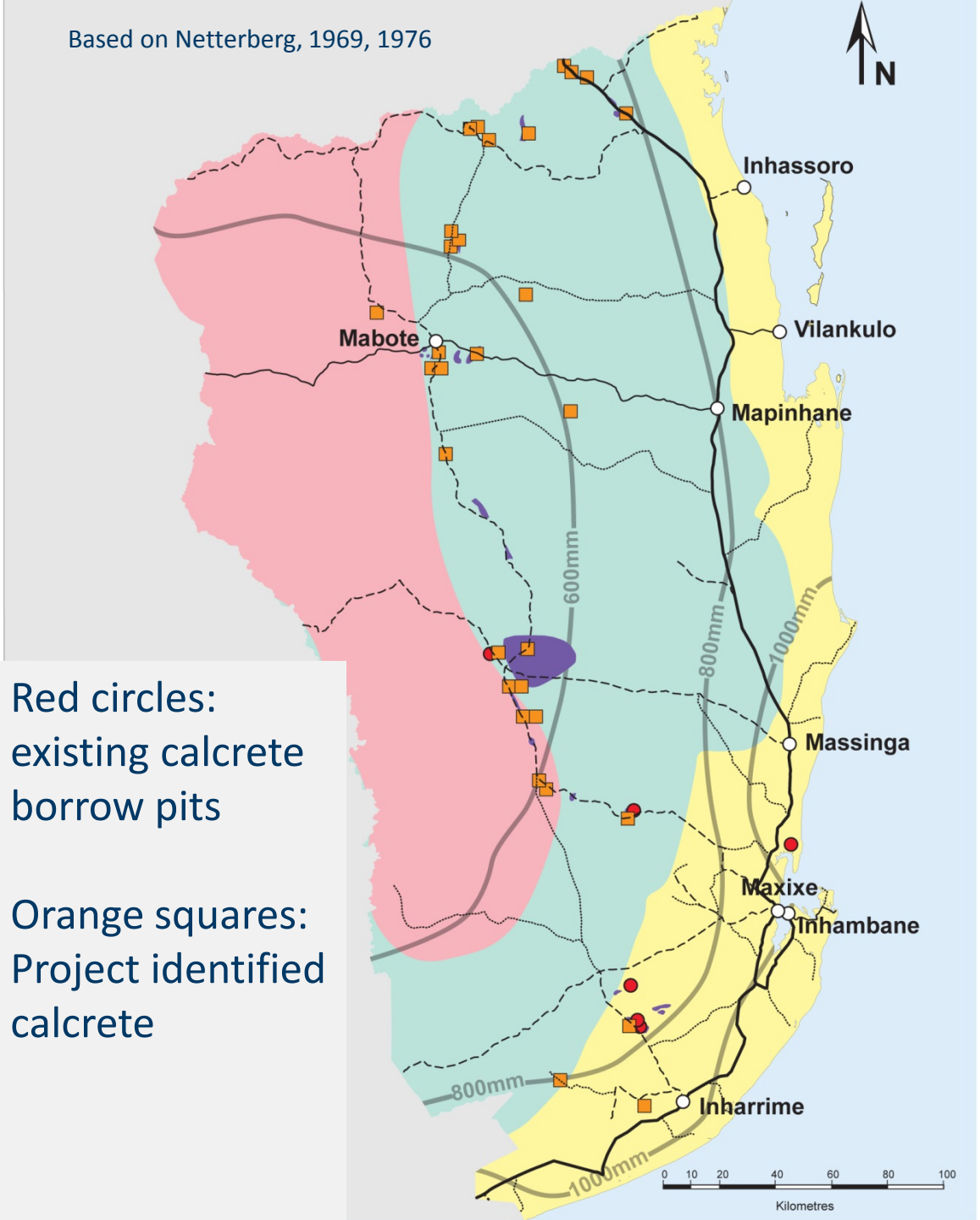
Activity 4: Trial pit investigation



- 13 locations of the 20 were investigated
- Probing was undertaken at each intersection and a trial pit excavated in the approximate centre
- Each trial pit was logged & a sample taken of each calcrete horizon

Out of the 13 trial pit locations, calcrete was confirmed in 10, 1 yielded Tertiary Limestone and 2 sand

Activity 5. Future prospecting



Red circles: existing calcrete borrow pits

Orange squares: Project identified calcrete

Prediction based on rainfall map of Southern Africa:

Pink: all types of calcrete
Blue: scattered nodules only
Yellow: No calcrete

No clear relationship with rainfall distribution alone

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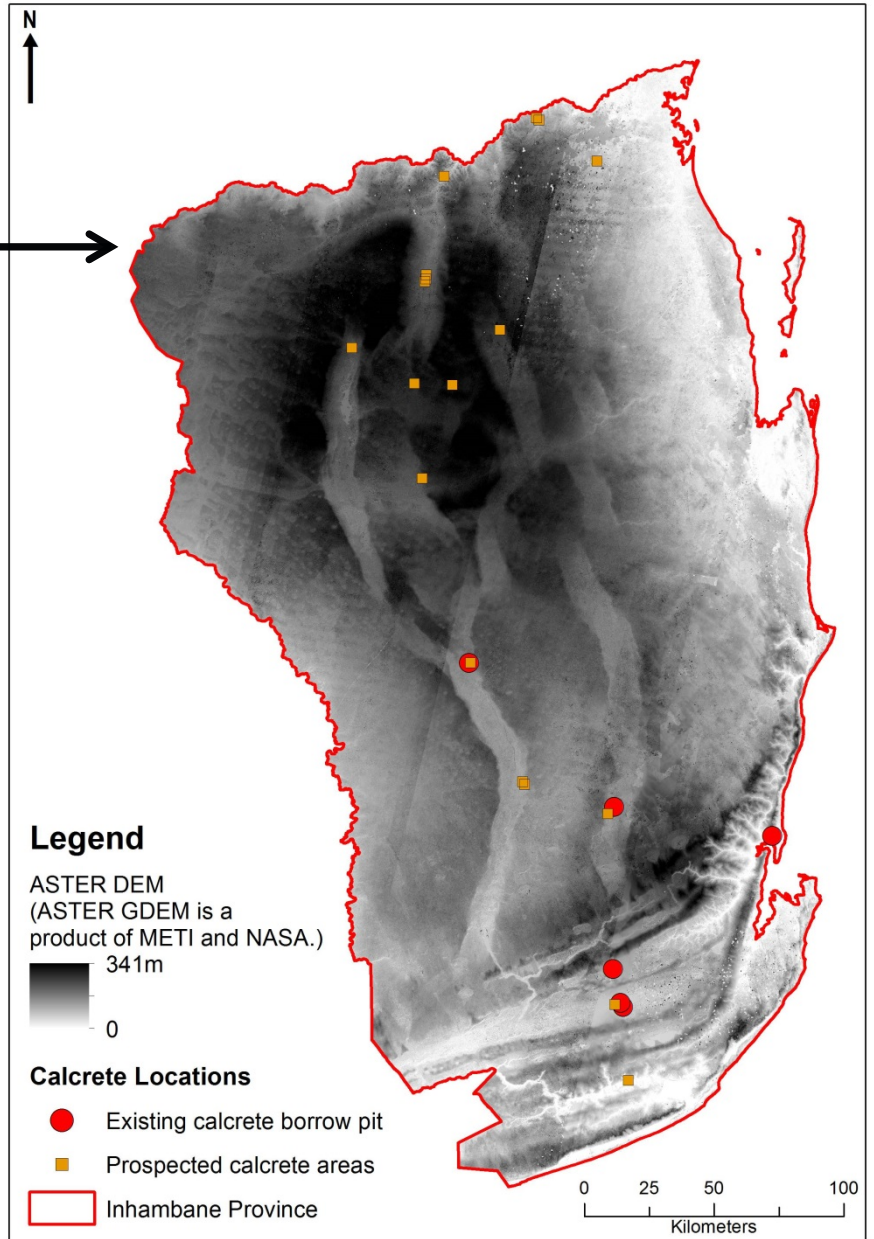
Prediction from Google Earth SPOT & ASTER DEM

2006 SPOT used to identify areas of grey soil & poor vegetation cover

ASTER used to identify depressions & low-lying areas

This allowed 36 potential further locations of calcrete to be identified



5. Conclusions

1. Common indicators of the presence of calcrete were identified
2. Mapping of these indicators allowed 20 new potential calcrete sources to be identified
3. Trial pitting revealed a 90% success rate
4. Lab tests confirmed material suitability for road construction
5. The roads authority now has a proven technique to prospect for further sources from freely-available satellite imagery
6. Rural roads in Inhambane Province can now be constructed and maintained more cost-effectively
7. This will lead to improvements to the rural economy & social welfare
8. The technique can be expanded to other provinces to benefit Mozambique as a whole

Thank you!

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