AFRICA

VREDEFORT DOME

SOUTH AFRICA

WORLD HERITAGE EVALUATION – IUCN TECHNICAL EVALUATION

VREDEFORT DOME (SOUTH AFRICA) ID No N1162

1. DOCUMENTATION

i) **Date nomination received by IUCN:** April 2004

ii) **Dates on which any additional information was officially requested from and provided by the State Party:** IUCN letters requesting supplementary information were sent on 26 October 2004, after the field visit, and 10 January 2005, following the IUCN WH Panel. State Party responses were received on 8 December 2004, and 29 March 2005.

iii) **IUCN / WCMC Data sheet:** 2 references (one reference with 47 citations)

iv) **Additional Documentation Consulted:** Brink, M., Waanders, F., Bisschoff, A.A. 2004. **IUCN Technical Evaluation: Vredefort Dome, 30th August 2004, Geological Aspects**. Paper prepared for the IUCN Mission, Vredefort Dome, South Africa, August 2004. Planetary and Space Science Centre 2004, Department of Tourism, Environmental and Economic Affairs, Free State. Brink, M.C., Bischoff, A.A., Wanders, F.B., Schoch, A.E. 2005. **An addendum to the supplementary information document on the Vredefort Dome. Earth Impact Database, Impact Cratering on Earth** (including World Impact Structures sorted by location) University of New Brunswick. http://www.unb.ca/passc/ImpactDatabase/essay.html. Brink, M, Bisschoff, A.A., Waanders, F. 2004. **The Vredefort Impact Structure**, **Potschefstroom, South Africa.** Brink, M.C., Waanders, F.B., Bisschoff, A.A., Gay, N.C. 2000. **The Foch Thrust-Potschefstroom Fault structural system, Vredefort, South Africa: a model for impact-related tectonic movement over a pre-existing barrier.** Journal of African Earth Sciences, Vol 30, No 1, pp. 99-117. Elsevier Science Ltd Great Britain. Bisschoff, A.A. 1999, **The Geology of the Vredefort Dome (and Geological Sheets).** Council for Geoscience, Geological Survey of South Africa. Explanation of Sheets 2627CA, CB, CC, CD, DA, DC. 2727AA, AB, BA. Scale 1:50,000. Gibson, R.L., Reimold, W.U. 1999 **Field Excursion through the Vredefort Impact Structure**. Department of Geology, University of Witwatersrand, South Africa. French, B.M. 1998, **Traces of Catastrophe. A Handbook of Shock-Metamorphic Effects in Terrestrial Meteorite Impact Structures** Lunar and Planetary Institute, Houston USA. Glikson, A.Y. 1996. **Mega-impacts and mantle-melting episodes: tests of possible correlations.** AGSO Journal of Australian Geology and Geophysics, 16 (4) pp. 587-607. Grieve, R.A.F., Pilkington, M. 1996. **The signature of terrestrial impacts**. AGSO Journal of Australian Geology and Geophysics, 16 (4) pp. 399-420. Sutherland, F.L. **The Cretaceous/Tertiary-boundary impact and its global effects with reference to Australia.** AGSO Journal of Australian Geology and Geophysics, 16 (4) pp. 567-585. Shoemaker, E.M., Shoemaker, C.S. 1996. **The Proterozoic impact record of Australia.** AGSO Journal of Australian Geology and Geophysics, 16 (4) pp. 379-398.

v) **Consultations:** 7 external reviewers, including ICOMOS. Officials from South Africa National, Provincial and District governments, representatives of community organisations and individuals.

vi) **Field Visit:** Graeme Worboys, August 2004

vii) **Date of IUCN approval of this report:** April 2005

2. SUMMARY OF NATURAL VALUES

The nominated serial property, Vredefort Dome, is located approximately 120 km to the south and west of Johannesburg, South Africa. Covering a total area of 30,111ha, the serial property includes a main core component of 30,108 ha, and three smaller (each 1 ha in size) component sites - two to the west, and one to the south east of the core area. The three satellite sites were added to the nomination, following discussions with IUCN, to include special outlier geological (outcrop) sites of significance to the overall geological story told at the nominated property.

The Vredefort Dome straddles the westerly flowing Vaal River, which also forms the administrative boundary of the Northwest Province and the Free State Province. It is a representative part of a larger meteorite impact structure (or astrobleme) which has a radius of impact of 190 km. The eastern boundary of the distorted north easterly trending oval shaped core component of the serial property is found 5 km from the town of Parys, with its western boundary located some 19 km from the town. The southern boundary of the core component area lies about 6 km to the north of the town of Vredefort, and the northern boundary is about 26 km to the north of the town.

Meteorite impact has played a significant part in the geological history of the Earth. Geological activity on the Earth's surface means that the evidence of the majority of impacts has disappeared (in contrast to the prominent remains of such impact sites on the Moon). The largest meteorite impact craters are testament to catastrophic

changes in the record of the planet and life on Earth: these impacts would have caused devastating global changes, and some scientists believe some may be the cause of major evolutionary changes, including mass extinctions in the fossil record. This specialised and scarce group of geological sites therefore form a critical part of the evidence of Earth's geological history and the understanding of the evolution of the planet.

The Vredefort Dome meteorite impact structure is the oldest (2023 million years) and largest (radius 190 km) so far found on earth. It is one of only three meteorite impact structures known with a diameter greater than 150 km, the other two being the structurally deformed Sudbury meteorite impact structure in Canada (1800 million years) and the buried Chicxulub meteorite impact structure in Mexico (60 million years). Chicxulub is also famous for its links to the demise of the dinosaurs at the end of Cretaceous (Table 1). The Vredefort Dome meteorite impact structure is one of about 200 meteorite impact structures currently known on the earth (Table 2). It is also the most deeply eroded impact structure known, with current levels of exhumation between 8 and 11 km.

Table 1: Terrestrial meteorite impact structures larger than 10km crater diameter (After French, 1998)

Crater diameter	Approx projectile diameter	Energy (TNT) equivalent	Mean impact frequency (Earth: No. per million yrs)	Mean impact interval (Earth)	Comparable terrestrial event
10km	500m	11,000 MT	10	100,000yr	Bosumtwi Meteorite Impact Crater, Ghana
20km	1km	87,000 MT	7.1	350,000yr	Ries Meteorite Impact Crater, Germany
50km	2.5km	1,300,000 MT	0.22	4.5m.y.	Charlevoix Meteorite Impact Structure, Canada
100km	5km	11,000,000 MT	0.04	26m.y	Popigai Meteorite Impact Structure, Russia
200km	10km	87,000,000 MT	0.007	150m.y.	Largest known terrestrial impact structures, Sudbury Canada, Vredefort Dome, South Africa

Table 2: Meteorite impact structures larger than 10km (Earth Impact Data base, 2002, Brink et al, 2004)

Diameter	Meteorite impact structures
10-49 km	Ames, USA; Aorounga, Chad; Araguainha, Brazil; Avak, USA; Azuara, Spain; Boltysh, Uktraine; Bosumtwi, Ghana; Carswell, Canada; Clearwater East, Canada; Clearwater West, Canada; Deep Bay, Canada; Dellen, Sweden; Eagle Butte, Canada; El'gygytgyn, Russia; Gosses Bluff, Australia; Gweni-Fada, Chad; Haughton, Canada; Janisjarvi, Russia; Kaluga, Russia; Kamensk, Russia; Karla, Russia; Kelly West, Australia; Kentland, USA; Lappajarvi, Finland; Lawn Hill, Australia; Logancha, Russia; Logoisk, Belarus; Manson, USA; Marquez, USA; Mistastin, Canada; Mjolnir, Norway; Montagnais, Canada; Nicholson, Canada; Oasis, Libya; Obolone, Ukraine; Ries, Germany; Rochechouart, France; Saint Martin, Canada; Serra da Cangalha, Brazil; Shoemaker, Australia; Sierra Madera, USA; Slate Islands, Canada; Spider, Australia; Steen River, Canada; Strangways, Australia; Suavjarvi, Russia; Upheaval Dome, USA; Ust-Kara, Russia; Vargeao Dome, Brazil; Wells Creek, USA; Zhamanshin, Kazakhstan.
50-99km	Acraman, Australia; Beaverhead, USA; Charlevoix, Canada; Chesapeake Bay, USA; Kara, Russia; Kara-Kul, Tajikistan; Morokweng, South Africa;Puchezh-Katunki, Russia; Siljan, Sweden; Tookoonooka, Australia; Woodleigh, Australia.
100-199km	Chicxulub, Mexico (170km); Manicouagan, Canada (100km); Popigai, Russia (100 km).
>200km	Sudbury, Canada (250 km); **Vredefort Dome, South Africa (380 km).**

There are two basic types of meteorite impact structures: simple structures of up to 4 km in diameter, with uplifted and overturned rim rocks surrounding a bowl shaped depression partially filled by breccia; and complex structures, generally 4km or more in diameter, with a distinct central uplift in the form of a peak and/or ring, an annular tough, and a slumped rim. Most terrestrial meteorite impact structures that have formed on earth

have been obliterated by terrestrial geological processes over time, and many are buried.

2.1 Evolution of the Vredefort Dome meteorite impact structure

The impactor that formed the meteorite impact structure at the nominated property was either a large body such as an asteroid with a diameter of about 12 km traveling at a relative velocity of 20 km/sec, or a smaller one, such as the head of a comet, approaching at a much higher speed. The impact event created the greatest single energy release event known for the surface of the earth. The meteorite impact structure was estimated to have been created in about 4 hours. Major stages in the evolution of the structure are described below:

Stage One: At impact. A shockwave is generated at the moment of impact, followed by the excavation of a transient crater, the delamination of the earth's crust and its transport away from the impact point occurs.

Stage Two: Transient excavation. More material is accelerated away from the impact point, folding is starting to develop and a dent is starting to form. As the dent deepens, there is further outward acceleration of material away from the centre, and old Vredefort Dome fault surfaces are reactivated, and assume the role of a fortuitously placed ramp. A thrust system is formed by material moving over the ramp surface. Rock around the impact site is extremely highly compressed. As the crater reaches its final depth, gravitational sliding of material back into the crater takes place.

Stage Three: Rebound. The inner zone, situated within the newly formed final crater, rebounds. A much larger central cone is formed, underlain by a mantle dome. The dent is now modified to assume the shape of an annular syncline as the rebound accentuates. Along the sides of the uplifted central cone, beds are first overturned above a detachment surface and broken by faulting to form lingoidal nappes (thought to be unique to the Vredefort Dome). Inward-moving material starts falling back over the slopes of the uplifted cone. Equilibrium occurs and 1500 million years of erosion commences.

Stage Four: The Present. The eroded meteorite impact structure protrudes from below more recent sediments (The Karoo), with its granite basement rock core and the overturned collar forming major features of the central part of the nominated property. Despite the broadly circular and subvertical orientation of the strata around the collar of the dome, the structure is complicated on a smaller scale by both folding and concentric and vertical radial faults. Rocks and geological structures exhibit a mixture of compressional and extensional stress effects. The annular syncline, the basement rock dome and erosion resistant strata of the overturned collar help define the ring structure of the meteorite impact structure.

2.2 Vredefort Dome meteorite impact structure evidences

The rock exposures and geological evidences of the meteorite impact structure are very clearly displayed at a number of key locations.

1. Shape: The characteristic circular or ring shape of a meteorite impact structure is clearly demonstrated at Vredefort Dome. The annular syncline surrounds the inner mountainous ring. Part of this mountainous area is found in the nominated property.

2. Evidence of great energy release: The extreme physical conditions imposed by shock waves of impact intensity produce unique, recognizable, durable shock metamorphic effects including planar deformation features (microscopic features in quartz and feldspar); shatter cones; impact-related breccias or pseudotachylite; chocolate tablet brecciation (stress release in a very hard rock type); polymorphs of quartz (coesite and stishovite); and, possible impact melting. These are all found at the Vredefort Dome. The property is also the type locality for pseudotachylite for the world. No crater–fill breccias or ejecta deposits have so far been found at the Vredefort Dome. Had they existed, they would have been removed by the extensive period of erosion that lasted for about 1500 million years.

3. Evidence from structural features: The detachment surface or fault plane (above which the rock displacement occurred) is evident at the property in ramp faults that underlie nappes. There are multiple structural features associated with this meteorite impact structure.

4. Evidence of deep crustal material exposed on the surface: Thanks to the meteorite impact and rebound effects (and subsequent erosion), the core-portion of nominated property represents the equivalent of a borehole, drilled into the earth to a depth of 25 km. Deep crustal rock types, including granulite-hornfels facies grade metamorphics, are found.

2.3 Vredefort Dome meteorite impact structure: the scenic, landscape and natural and cultural heritage values of the nominated area

The nominated property includes part of the ring structure and a cross-section of the geological formations and structures that provide evidence for the impact. At a landscape scale, the magnitude of the ring structure diameter can be appreciated from vantage points within the nominated property. The magnitude of the forces which contributed to forming the overturned, steeply dipping and highly faulted hills of the Vredefort Dome can also be better appreciated at this landscape scale. The steepest gradient of the Vaal River is found where it courses through the Vredefort Dome hills giving rise to rapids, irregular stream patterns and islands, and a range of riverine habitats. Short, sharp streams have formed steep gullies and valleys that have cut into these hills. Flora mapping of the nominated property recognises 5 broad communities including the dolomite grasslands, andesite mountain bushveld, gold reef mountain bushveld, Vredefort Dome granite grassland and the riverine bushland. The area is very rich for some native species (butterflies), and includes many native birds, mammal species and other fauna. There are large areas of natural lands within the nominated property, and many areas are being rehabilitated to their natural habitat for game farming. The property contains evidence of past human use including agriculture, mining and conflict, and has a rich cultural heritage. There are many areas which are partly or intensively modified for

agriculture and ecotourism. The natural and cultural values of the property (other than the geological meteorite impact phenomena) complement the geological attributes.

3. COMPARISON WITH OTHER COMPLEX METEORITE IMPACT STRUCTURES

A detailed global comparative analysis was received in February 2005 as requested by IUCN. The multi-ring complex meteorite impact structure centred on the Vredefort Dome represents the oldest meteorite impact structure known for earth. The catastrophic, short duration impact that created this feature was the single greatest energy release event ever known to have affected earth (Table 3). Of the three largest meteorite impact structures, Vredefort Dome is not only the largest (380 km diameter) and oldest, but it has better exposures of impact evidences than either Sudbury (Canada) or Chicxulub (Mexico). Field inspections at Vredefort Dome clearly demonstrated the outstanding quality of the meteorite impact geological evidence. The property's structure provides the only structurally intact exposure of the basement, below the crater floor of a very large astrobleme. This is unique for the planet. It shows a geological section that reaches from the rocks which once covered the crater floor, through the floor, and down into the basement of the structure. The central cone of the crater rose (rebound) by approximately 38 km to provide a surface outcrop equivalent of mantle rocks obtained from the deepest borehole drilled on earth. These mantle rocks also show a type of metamorphism found only in conditions of very high energy release. This characteristic may be unique to the nominated property. It is not found at Sudbury and Chicxulub. The energy released created chocolate tablet boudinage in cherts, and their association with distally situated ring thrusts is also thought to be unique. The impact forces overturned 17 km (true thickness) of strata to dip towards the centre of the structure. No other similar terrestrial phenomenon of this nature, of a comparable magnitude has (probably) been observed. Like other complex impact structures, Vredefort Dome includes examples of shatter cones, planar deformation features in minerals, high pressure mineral polymorphs. It does not include evidences of impact melts. In conclusion, the nominated property, has high quality exposures of a complex meteorite impact event that are readily accessible. It is a high quality representative example of a meteorite impact structure and has special significance given its status as evidence of the world's greatest single event release of energy. It is the world's only structurally intact exposure of the basement, below the crater floor, of a very large astrobleme. It provides the only mappable and restorable profile that illustrates the genesis and development of an astrobleme during the very short time after impact. A brief comparison relative to the world's 3 largest meteorite impact structures is provided in Table 3. The criteria cover aspects of significance in relation to all the relevant aspects of World Heritage natural criterion (i).

Table 3: Comparison, Earth's 3 largest known meteorite impact structures

Complex meteorite impact structure	Diameter (km)	Estimated energy released	Some surface exposure	Totally buried	Subsequent deformation	Link to major event in earth's history	Evidence of meteorite impact
Vredefort Dome, South Africa	380	87 million megatons (plus)	Yes	No	No	Impact at 2.2 billion yrs (the end of a large scale bombardment? Eukaryote / Prokaryote boundary?	HD; E; LG: Circ; Mult Rings; Cent; PDF; Coes; Stish; Brecc; Shatt; Melt (rare); Det Fault; Faults, Folds
Sudbury Canada	250	87 million megatons	Yes	No	Yes	Impact at 1.8 billion yrs	DEF; HD (upper part); Brecc; Melt
Chicxulub, Mexico	170	87 million megatons	No	Yes	No	60 million yrs. End of the dinosaurs	This site is buried

Key to Table 3: Meteorite impact structure evidence

A) State of preservation
HD: High degree of preservation of meteorite impact evidence
LG: Landscape geomorphic evidence
DEF: Deformed meteorite impact evidence
W: Weathered meteorite impact evidence
E: Meteorite impact evidence eroded

B) Meteorite impact evidence
Circ: Circular ring structure and annular syncline
Mult Rings: multiple rings
Cent: Central structural uplift evidence
PDF: Planar deformation features (characterised by microscopic effects in quartz or feldspar)
Stish: Quartz polymorph mineral Stishovite
Coes: Quartz polymorph mineral Coesite
Brecc: Impact related breccia (mylonite to pseudotachylite)
Choc Tab: Chocolate tablet brecciation (characteristic of stress release in a very hard rock type)
Shatt: Shatter cones
Melt: Impact melting. Crystallisation of rock from a molten stage
Crat Fill: Crater-fill breccias
Eject: Ejecta deposits
Det Fault: Detachment fault surface
Faults: Multiple faulting evidences associated with the impact structure
Folds: Folds and over folds associated with the impact structure

4. INTEGRITY

4.1 Land Ownership

The nominated serial property straddles the Vaal River and is located within the Free State and Northwest Provinces. It is comprised of 149 private properties, 91 of which are located within the Northwest Province (18,859 ha), and 58 the Free State Province (11,252 ha). There are 600 ha of state owned land within the nominated core component.

4.2 Management and planning framework

The land within the nominated property is predominantly agricultural, has freehold status, and is subject to national, provincial and district statutory regulations. The following national legislation is applicable: The World Heritage Convention Act 49 of 1999; the National Heritage Resources Act 25 of 1999; the National Environmental Managements Act 107 of 1998 and the Physical Planning Act 88 of 1967. At the Provincial level, the Northwest and Free State Provinces have applicable nature conservation ordinances regulating environmental aspects of the area. At the local level, the nominated property falls within the District Municipalities of Northern Free State and Southern District North West, and the Local Municipal areas of Potschefstroom (Northwest Province) and Parys (Free State Province), and their environmental regulations.

In December 2002, the South African National Heritage Resources Agency decided, in principle, to declare the nominated property a National Heritage Site under the provisions of the National Heritage Resources Act 25 of 1999 subject to a Cultural Heritage Survey and Management Plan being completed. This document has been completed (February 2005) although no advice of the formal declaration of the National Heritage Site had been received as of March 2005.

In 2004, interim government management structures and actions were put in place in recognition of the potential World Heritage status of the nominated property. They include: *The Vredefort Dome Inter-provincial Task Team* which is coordinating the process of obtaining World Heritage status and providing interim technical and administrative management (until a Management Authority is appointed under the World Heritage Convention Act, 1999). The *Inter-provincial Task Team* is commissioned to develop an *Integrated Management Plan* for the serial property in accordance with the World Heritage Convention Act. Part of this process includes Northwest Province preparing a *Development Plan* (a spatial plan which includes a Strategic Environmental Assessment of the area) and a *Management (zoning plan) Plan.* This work aims to enhance the stature of the Vredefort Dome as a potential National Heritage site and a potential World Heritage site. A *Vredefort Dome Steering Committee* (involving District and Local Municipalities, Provincial, and National Government representatives) has been established to oversee the process of obtaining World Heritage status and the appointment of a Management Authority. A *Vredefort Dome Stakeholder Forum* has been established for public participation and awareness raising about obtaining World Heritage status and the establishment of a Management Authority.

A Vredefort Dome Bergland Conservancy has been established by private landowners in the Northwest Province as a Section 21 Company. The main objectives of the Conservancy are to convert the private properties of the area into a voluntary nature reserve, and to conserve its unique aspects. The Conservancy has prepared a management plan to facilitate these objectives. It will be represented in the *Stakeholder Forum,* and it plays an important role in the facilitation of private landowner's involvement in the nominated property.

A *Vredefort Dome Conservancy* has also been established in the Free State Province by private landowners following the IUCN field mission.

4.3 Traditional protection mechanisms

Traditional intensive agriculture in the nominated property is reported to be diminishing, with rehabilitation of natural vegetation, game farms, and ecotourism based on the natural attributes, including the Vaal River riparian area becoming more important. The greatest protection currently afforded to many of the outstanding and sensitive geological (outcrop) sites is the general lack of publicity and awareness of their significance.

4.4 Public support

Consultations with national, provincial, and municipality officials, elected representatives and local school children demonstrated strong support for the nominated property. Support for and knowledge of the WH nomination by the 149 private property owners within the serial nomination was also evaluated. Assisted by the Dome Bergland Conservancy, it was found that not all landowners within the nominated property may be aware of the potential WH status for their land and the ramifications of this status. This has been recognised by the *Inter-provincial Task Team*, and the *Stakeholder Forum* has been designed to raise awareness of the proposal. In February 2005, this work was still being completed. Landowners of the 3 satellite sites separate from the core component area have been contacted, and are supportive of the nomination.

4.5 Site management

The VD Inter-provincial Task Team has assumed management of the nominated property for the interim period commencing 2004. Normal private property agricultural activities, ecotourism and game farming will continue to occur within the nominated property. Special planning provisions will be required to ensure the protection of the scenic landscape attributes of the meteorite impact structure. Active individual site management will be required to protect the three satellite component sites.

4.6 Boundaries

Roads have been used to define the boundary of core component of the nominated property. This is a clear

boundary. Each of the additional three component sites which make up the serial nomination are located in open, agricultural land and will be fenced to identify their boundaries. These 3 sites have been identified (February 2005) as being circular in shape around the geological outcrop and about 1 hectare in area. These circular boundaries are interpreted to be indicative and more definitive practical boundaries are needed. In addition, the eastern disjunct site (the pseudotachylite site) lies immediately adjacent to the core area, which could potentially be expanded to include this area.

4.7 Threats

The major threats to the integrity and functioning of the nominated property are:

Site level: theft or vandalism to the geological evidence
The three satellite component sites, including the stromatolite site, the chocolate tablet brecciation site, and the shatter cone site are all vulnerable to theft and vandalism, and require management and supervision. At least two of the component sites (the stromatolite and chocolate tablet breccia sites) are so site-specific, valuable and vulnerable, that they may require special, small exhibition buildings and on-site supervision to permanently protect them.

Nominated area level: development
The essentially rural and natural scenic amenity of the nominated property and the "ring structure" landscape adds to the integrity of the nominated property. Appreciating the immensity of the meteorite impact ring structure requires a landscape scale vista. Urbanisation of parts or the entire nomination property would diminish the natural-rural scenic value and impact of the "ring structure" landscape. It would also impact on the important remaining natural values. Independent development actions of property owners within the nominated property could also have an impact. Mining is not considered to be a threat to the nominated property, though quarrying for granite could be. The polluted state of the Vaal River diminishes the natural values of the area.

Tourism and visitor access
Legal access will need to be achieved for visitors to the three small component sites and access will need to be negotiated with private property owners within the nominated property. Uncoordinated and unsupervised tourism access could threaten the integrity of the geological evidence as well as cause impacts to access and landscape scale scenery. Unplanned or ad hoc tourism developments could jeopardize the scenic amenity of the property. Therefore, active management of tourism will be needed.

4.8 Concurrence with all relevant "Conditions of Integrity"

The World Heritage conditions of integrity for the Vredefort Dome nomination are:

Section 44 b (i): Contain all or most of the key interrelated and interdependent elements

The current nominated serial property includes key geological (outcrop) sites which demonstrate classic complex meteorite impact structure phenomena.

Section 44 b (v): Should have a management plan
The serial nominated property currently does not have a management plan. The *Inter-provincial Task Team* is currently in the process of investigating and preparing such a plan.

Section 44 b (vi): Should have adequate long-term legislative, regulatory, institutional or traditional protection.
The status of private property for the majority of the serial nominated property will require special land use planning requirements to ensure the aesthetic rural/ natural landscape and the key satellite component sites are protected, that public access is available, and that active conservation management is possible. These provisions are critical. The *Inter-provincial Task Team* is currently investigating these requirements. Final practical boundaries for the 3 satellite component sites of the serial nomination need to be made clear and precise.

5. APPLICATION OF WORLD HERITAGE NATURAL CRITERIA

Vredefort Dome is nominated for inscription under natural criterion (i)

Criterion (i): Earth's history and geological features

Vredefort Dome is the oldest, largest, and most deeply eroded meteorite impact structure in the world. It is the site of the world's greatest single, known energy release event. It contains high quality and accessible geological (outcrop) sites which demonstrate a range of geological evidences of a complex meteorite impact structure. The rural and natural landscapes of the serial property help portray the magnitude of the ring structures resulting from the impact. The serial nomination is considered to be a representative sample of this meteorite impact structure. A comprehensive comparative analysis with other complex meteorite impact structures demonstrated that it is the only example on earth providing a full geological profile of an astrobleme below the crater floor, thereby enabling research into the genesis and development of an astrobleme immediately post impact. IUCN considers that the nominated property meets this criterion.

6. DRAFT DECISION

IUCN recommends that the World Heritage Committee adopt the following draft decision:

The World heritage Committee,

1. *Having examined Document* ***WHC-05/29.COM/8B***

2. *Inscribes the Vredefort Dome, South Africa, on the World Heritage List on the basis of natural criterion (i)*

Criterion (i): *Vredefort Dome is the oldest, largest, and most deeply eroded complex meteorite impact structure in the world. It is the site of the world's greatest single, known energy release event. It contains high quality and accessible geological (outcrop) sites which demonstrate a range of geological evidences of a complex meteorite impact structure. The rural and natural landscapes of the serial property help portray the magnitude of the ring structures resulting from the impact. The serial nomination is considered to be a representative sample of a complex meteorite impact structure. A comprehensive comparative analysis with other complex meteorite impact structures demonstrated that it is the only example on earth providing a full geological profile of an astrobleme below the crater floor, thereby enabling research into the genesis and development of an astrobleme immediately post impact.*

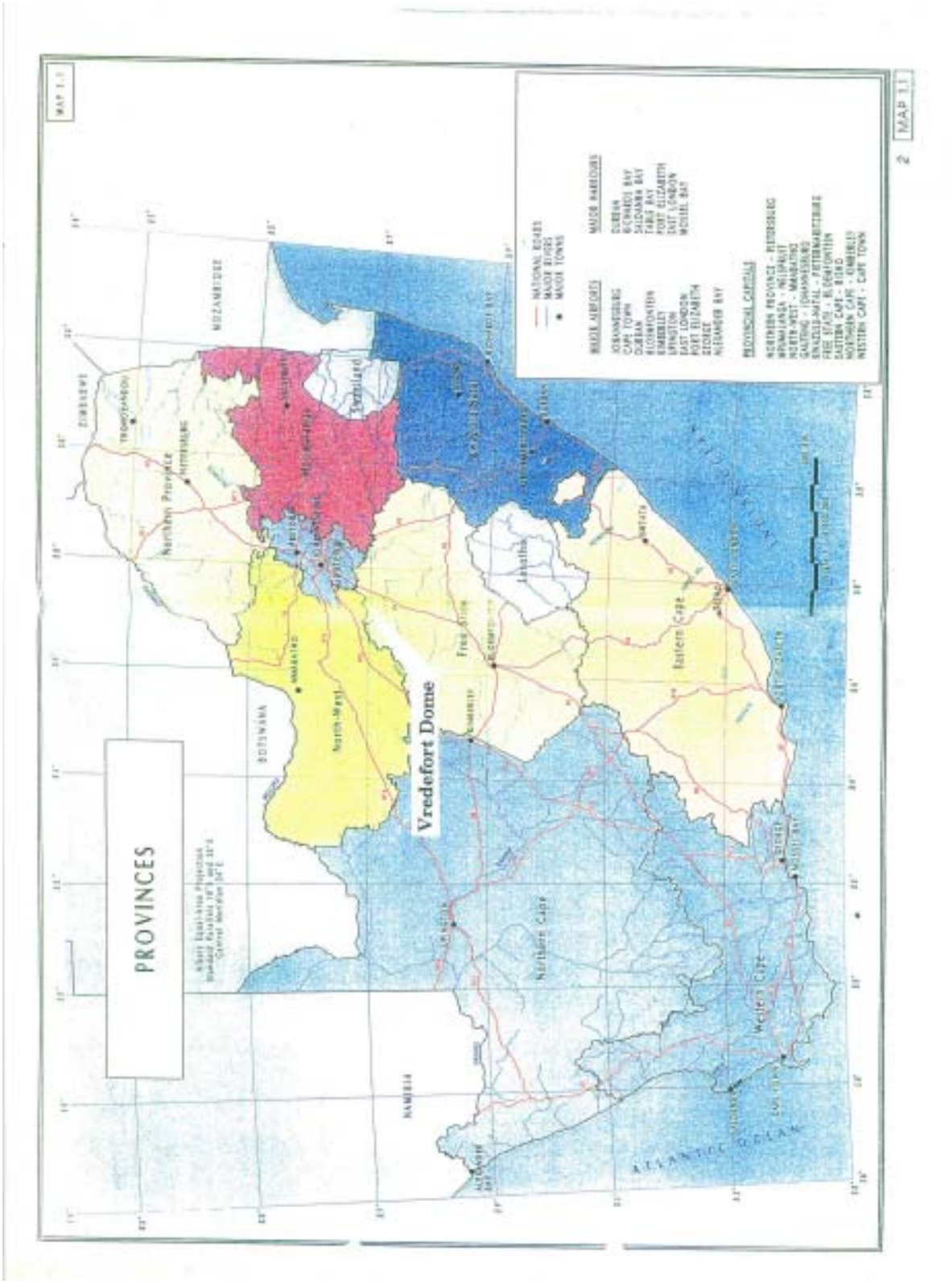
3. *Noting that the freehold status of the majority of the nominated property requires special management and collaboration with landowners to ensure the integrity of the property,*

4. *Requests the State Party to clearly define the legal boundaries for the three satellite component sites of the serial property,*

5. *Requests the State Party to complete and start to implement the management plan for the entire property within 2 years of inscription, and ensures that this plan has the support of key stakeholders;*

6. *Further requests the State Party to invite an IUCN mission within 2 years of inscription to evaluate progress with the above actions.*

Map 1: General Location of nominated property



Map 2: Boundaries of nominated property