The effects of large impacts during the Flood year

Despite my respect for Michael Oard for his contribution to creation science I cannot help but disagree with his 'out-of-this-world' theory on the origin of large cratonic basins[1]. He proposes that large cratonic basins were 'likely' formed by meteorite impacts at the onset of the Flood, since they exhibit features that are expected from extraterrestrial impacts. I would like to address the question, 'what can we expect from large impacts during the Flood year', by referring to the confirmed largest (and oldest in uniformitarian terms) impact structure on the planet, the Vredefort Dome in South Africa. Oard briefly mentioned this example, but might have failed to investigate what evidence has been left by this giant impact.

The Vredefort 'Dome' is a term that confuses the average tourist to the area. Most are aware that it qualifies as the world's oldest and largest recognised impact structure,[2] and therefore expect to see a crater. The Dome is only part of the structure, and is a geological term that refers to a 40–50 km diameter[3,4] granitoid (various granites and gneisses) pluton that popped up in the centre of this structure. Granite is normally expected to be found buried several kilometres below various layers of sedimentary rock as 'foundation rocks', hence the term 'basement' granite. Only in isolated cases have the granitoids been exposed on surface, like at Vredefort.

The granitoid dome is surrounded by a 15–25 km wide[3,4] rim or collar of up-and-overturned sedimentary layers of Witwatersrand, Ventersdorp and even Transvaal Supergroup rocks.[5] These rocks have uniformitarian ages ranging from 3,200 Ma to 2,023 Ma—the time of the impact.[3] The oldest Witwatersrand rocks (clastic sedimentary rocks including auriferous conglomerate layers) form the inner rim and are the steepest inclined. Further outwards the younger Ventersdorp Supergroup (mainly lavas) can be found while the overlying Transvaal rocks (clastic sedimentary rocks and dolostone) form the outer rim from where outcrops extend outwards with dip angles returning to normal. The granitoid dome therefore popped up right through a minimum 15 km thick succession of clastic and volcano-sedimentary rocks that was blasted open by the impact. The enormous energy released by the impact caused a rebound effect (similar to a stone in water as Oard also explained in his article) which caused the basement granitoid to almost instantaneously well up.

Oard also mentioned the diagnostic evidence for impact sites as put forward by French and Koeberl.[6] These include shatter cones and planar deformation structures but contrary to their claim, shatter cones are quite abundant throughout the rim rocks around the Dome. Another diagnostic feature of Vredefort is pseudotachyllite (melt rock) breccias, especially in the granitoid dome. These features generally confirm the impact origin. The only question is when this happened within a biblical geology framework.

The pre-existing sedimentary rocks were deposited in three 'basins' corresponding to the Supergroup classifications; the Witwatersrand[7], Ventersdorp[8] and Transvaal[9] basins (figure 1)—each becoming successively larger. Since the sediments from all three 'basins' were impacted by the Vredefort event, the basins already existed at the onset of the Flood.

The impact had to have occurred during the Flood year before the waters receded. This is evident by the numerous water gaps in the collar

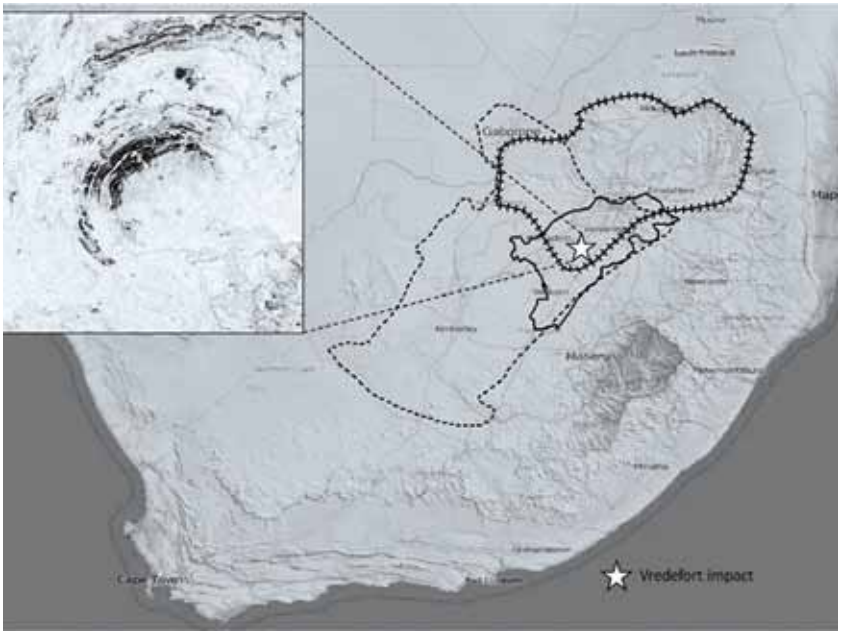

Figure 1. The inferred extent of the three 'basins' impacted by the Vredefort Dome event: Witwatersrand Basin (solid line), Ventersdorp Basin (dashed line) and the main Transvaal Basin (stitched line).

hills, and planation surfaces on the northern (outer) collar hills. On a regional scale, sheet erosion has removed (and redeposited) a lot of the overlying sediments after the impact, and we are left with the northwestern half of a relatively flat semi-circular structure. The southern and eastern outcrops of the collar rocks disappear unconformably beneath the first of the Karoo outcrops. The flat-lying Karoo layers were therefore deposited shortly after the impact.

The current topography (figure 2) is characterised by regional planation [10] (the granitoid dome is roughly on the same elevation as the rest of the countryside outside the Vredefort collar) and shallow channel erosion (not restricted to current rivers) corresponding respectively to the Abative and Dispersive Phases of the Recessive Stage of the Flood.[11] The valleys between the collar hills have been filled with unconsolidated valley fill during the Recessive Stage. This loose material would have been completely removed by erosion in only a few million years, and testifies to the relatively young age of the Dome.

In conclusion, it is now commonly accepted that this structure represents the impact site (astrobleme) of the largest meteorite to have hit our planet (apart from the stupendous moon formation-by-collision theory).[12] In our framework this impact event happened during the Flood year. But instead of forming a large crater basin as Oard proposed, it had the exact opposite effect. It caused the deep basement granite to instantaneously well up during the energy rebound, and pushed up the surrounding layers so much so that subsequent erosion has been estimated at several kilometres!

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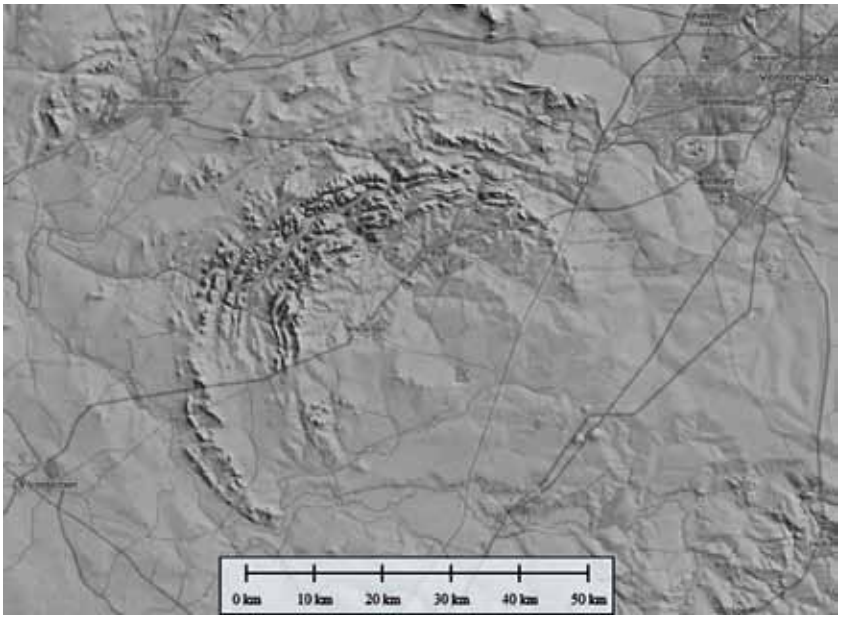

Figure 2. The regional topography around the Dome is relatively flat with localised drainage incisions and water gaps.

References

1. Oard, M.J., Large cratonic basins likely of impact origin, *J. Creation* **27**(3):118–127, 2013.
2. UNESCO's listing of the Vredefort Dome as a potential World Heritage Site, whc.unesco.org/en/list/1162, accessed 18 December 2013.
3. Gibson, R.L. and Reimold, W.U., The Vredefort Impact Structure, South Africa, The scientific evidence and a two-day excursion guide, Council for Geoscience, Pretoria, 2001.
4. Reimold, W.U., Impact Structures in South Africa; in: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J. (Eds), *The Geology of South Africa*, Geological Society of South Africa, Johannesburg, pp. 629–649, 2006.
5. Underlying the Witwatersrand Supergroup rocks we find the Dominion Group volcano-sedimentary rocks which form part of the collar, but I chose to ignore it due to scale compared to the Witwatersrand rocks.
6. French, B.M. and Koeberl, C., The convincing identification of terrestrial meteorite impact structures: what works, what doesn't, and why, *Earth-Science Reviews* **98**:123–170, 2010.
7. McCarthy, T.S., The Witwatersrand Supergroup; in: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J. (Eds), *The Geology of South Africa*, Geological Society of South Africa, Johannesburg, pp. 155–186, 2006.
8. Van der Westhuizen, W.A., de Bruiyn, H. and Meintjes, P.G. The Ventersdorp Supergroup; in: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J. (Eds), *The Geology of South Africa*, Geological Society of South Africa, Johannesburg, pp. 187–208, 2006.
9. Eriksson, P.G., Alterman, W. and Hartzer, F.J., The Transvaal Supergroup and its precursors; in: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J. (Eds), *The Geology of South Africa*, Geological Society of South Africa, Johannesburg, pp. 237–260, 2006.
10. Oard, M.J., The remarkable African Planation Surface, *J. Creation* **25**(1):111–122, 2011.
11. Walker, T., A biblical geological model; in: Walsh, R.E. (Ed.), *Proceedings of the Third International Conference on Creationism*, Creation Science Fellowship, Pittsburgh, PA, pp. 581–592, 1994.
12. Oard, M.J., Problems for 'giant impact' origin of moon, *J. Creation* **14**(1):6–7, 2000.

» Michael J. Oard replies:

I thank Mr Johan Smit for his interest in impacts and his response to my article. The geology and geomorphology around the Vredefort structure is most interesting, especially the erosion, planation surfaces, and water gaps. I agree with Smit that the Vredefort impact occurred during the Flood, unlike during Creation Week, where some creationists place it.[1]

The Vredefort impact crater is believed to be 250 to 300 km in diameter, the largest on Earth so far recognized, but it is mostly a near-circular central uplift about 50 km in diameter formed by mantle rebound.[2] Moreover, the original roughly circular crater has been strongly deformed and distorted by tectonic events.[3] The Sudbury structure in Ontario, Canada,

has also been strongly distorted from a nice circular shape.[4] The Vredefort structure has been eroded around 5 to 10 km, explaining the lack of crater-fill breccia and impact melt.[5]

Regardless of evidence for an impact, the question whether the Vredefort structure was related to an impact was controversial for most of the 20th century.[6] This goes to show how cautious the uniformitarian scientists are in verifying impacts, probably because impacts were until recently considered impossible because of uniformitarianism.

The uniformitarian criteria for an impact feature are overly stringent,[7] focusing mainly on shatter cones and planar deformation structures (PDFs) in quartz and other minerals, while downplaying circular or arc-shaped structures.[8] Such criteria are in spite of the admitted difficulty of finding PDFs and shatter cones associated with many impacts, and that there are hardly any other geological processes, other than impacts, that can explain *large* circular or arc-shaped features.[9,10] It is not surprising that very few impact structures have been and will be recognized on just PDFs and shatter cones, and that is probably why there are many candidates waiting for recognition as impact structures.[6]

So, the Vredefort and Sudbury structures are special structures, and we should not expect all impacts on Earth to have produced similar structures. These structures may be partly representative of very early Flood impacts in which the crater was greatly deformed and eroded due to many impacts along with great tectonics, erosion, and deposition.

Whether a nice crater remains depends on crater modification after the transient crater is formed, and that depends upon a number of variables.[11] Craters are variously modified after the first hour, especially if thousands of impacts occurred early in the Flood.[12,13] (I believe God had to modulate this huge number of impacts). Moreover, craters larger than 300 km seem to have formed differently and have more variable morphology on Earth and the moon,[14] probably because at larger scales more variables come into play. Such large craters generally lack central uplifts, unlike the uplifts of the smaller Vredefort and Sudbury structures.

Based on the moon, the earth should have numerous craters greater than 300 km. The continental or cratonic basins I described[15] are very close to the morphology expected of large impacts greater than 300 km. The reason the general circular shape in two dimensions, or bowl shape in three dimensions, is still generally maintained, I think, is because these impacts came later in the Flood when there were fewer impacts to interfere with each other and conditions were different. Moreover, the cratonic basins likely were much less eroded than the Vredefort structure.

So, I thank Smit for his description of the Vredefort structure but I believe we are comparing apples to oranges. I believe cratonic basins are the additional craters greater than 300 km expected during the Flood, which lack a central uplift but keep its general impact morphology. Because of the chaos of the Flood, and the fact that uniformitarian scientists have overly stringent criteria for impacts and do not expect to find impact structures when they study cratonic basins, I believe cratonic basins will continue to remain unrecognized. Regardless, the morphology of cratonic basins is a powerful testimony for impact cratering early in the Flood.

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References

1. Snelling, A.A., *Earth's Catastrophic Past: Geology, Creation & the Flood*, Institute for Creation Research, Dallas, TX, 2009.
2. Tredous, M., Hart, R.J., Carlson, R.W. and Shirey, S.B., Ultramafic rocks at the center of the Vredefort structure: further evidence for the crust on edge model, *Geology* **27**(10):923–926, 1999.
3. Henkel, H. and Reimold, W.U., Integrated geophysical modelling of a giant, complex impact structure: anatomy of the Vredefort structure, South Africa, *Tectonophysics* **287**:1–20, 1998.
4. Dreuse, R., Doman, D., Santimano, T. and Riller, U., Crater floor topography and impact melt sheet geometry of the Sudbury impact structure, Canada, *Terra Nova* **22**:463–469, 201.
5. Lana, C., Gibson, R.L. and Reimold, W.U., Impact tectonics in the core of the Vredefort Dome, South Africa: implications for central uplift formation in very large impact structures, *Meteoritics & Planetary Science* **38**(7):1093–1107, 2003.
6. Koeberl, C., Reimold, W.U. and Shirey, S.B., Re-Os isotope and geochemical study of the Vredefort granophyre: clues to the origin of the Vredefort structure, South Africa, *Geology* **14**(1):913–916, 1996.
7. Glikson, A. and Uysal, I.T., Geophysical and structural criteria for the identificationof buried impact structures, with reference to Australia, *Earth-Science Reviews* **125**:114–122, 2013.
8. French, B.M. and Koeberl, C., The convincing identification of terrestrial meteorite impact structures: what works, what doesn't, and why, *Earth-Science Reviews* **98**:123–170, 2010.
9. Stewart, S.A., How will we recognize buried impact craters in terrestrial sedimentary basins? *Geology* **31**:929–923, 2003.
10. Sussman, A.J. and Weil, A.B. (Eds.), *Orogenic Curvature: Integrating Paleomagnetic and Structural Analyses*, GSA Special Paper 383, Geological Society of America, Boulder, CO, 2004.
11. Oard, M.J., What do impacts accomplish in the first hour? *J. Creation* **27**(1):90–98, 2013.
12. Oard, M.J., How many impact craters should there be on the earth? *J. Creation* **23**(3):61–69, 2009.
13. Spencer, W., Impacts and Noah's Flood—how many and other issues, *J. Creation* **27**(1):85–89, 2013.
14. Urrutia-Fecugauchi, J. and Perez-Cruz, L., Multiring-forming large bolide impacts and evolution of planetary surfaces, *International Geology Review* **51**(1):1079–1102, 2009.
15. Oard, M.J., Large cratonic basins likely of impact origin, *J. Creation* **27**(3):118–127, 2013.