NEW YORK'S PANTHER MOUNTAIN IMPACT CRATER: ENORMOUS GAS POTENTIAL WITHOUT HYDRAULIC FRACTURING

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This is a brief article about an old exploration well, a large reservoir of natural gas, the New York State Constitution, and thousands of homes and residents on the losing end. It's one of those predicaments that landmen, geologists, and engineers can encounter in their efforts to safely exploit a hydrocarbon-bearing reservoir, while at the same time attempting to satisfy state laws, officials, environmentalists, and others. Perhaps a more appropriate title for this article would be "*The Buried Crater That Couldn't…*"

Figure 1. The 10 km (6-mile) diameter Panther Mountain Meteorite-Impact Crater located 125 miles north of New York City in Ulster County, NY. The actual structure is buried beneath ~2,500 ft of overburden, but the surface expression is apparent in the encircling roads and creeks, the latter of which have downcut above the rim. Two areas of interest are the Herdman exploration well, which was drilled in 1955 and tested 50,000 cubic feet of gas per day (50 mcfd), and the Menla Mountain Retreat, which is the closest private land to the central uplift. The modest 50 mcfd gas rate at 5,350 ft depth in the Lower Devonian in the Herdman well is quite significant because this area of impact structures – between the central uplift and rim – does not usually produce any hydrocarbons. It suggests that the entire crater is gas bearing.

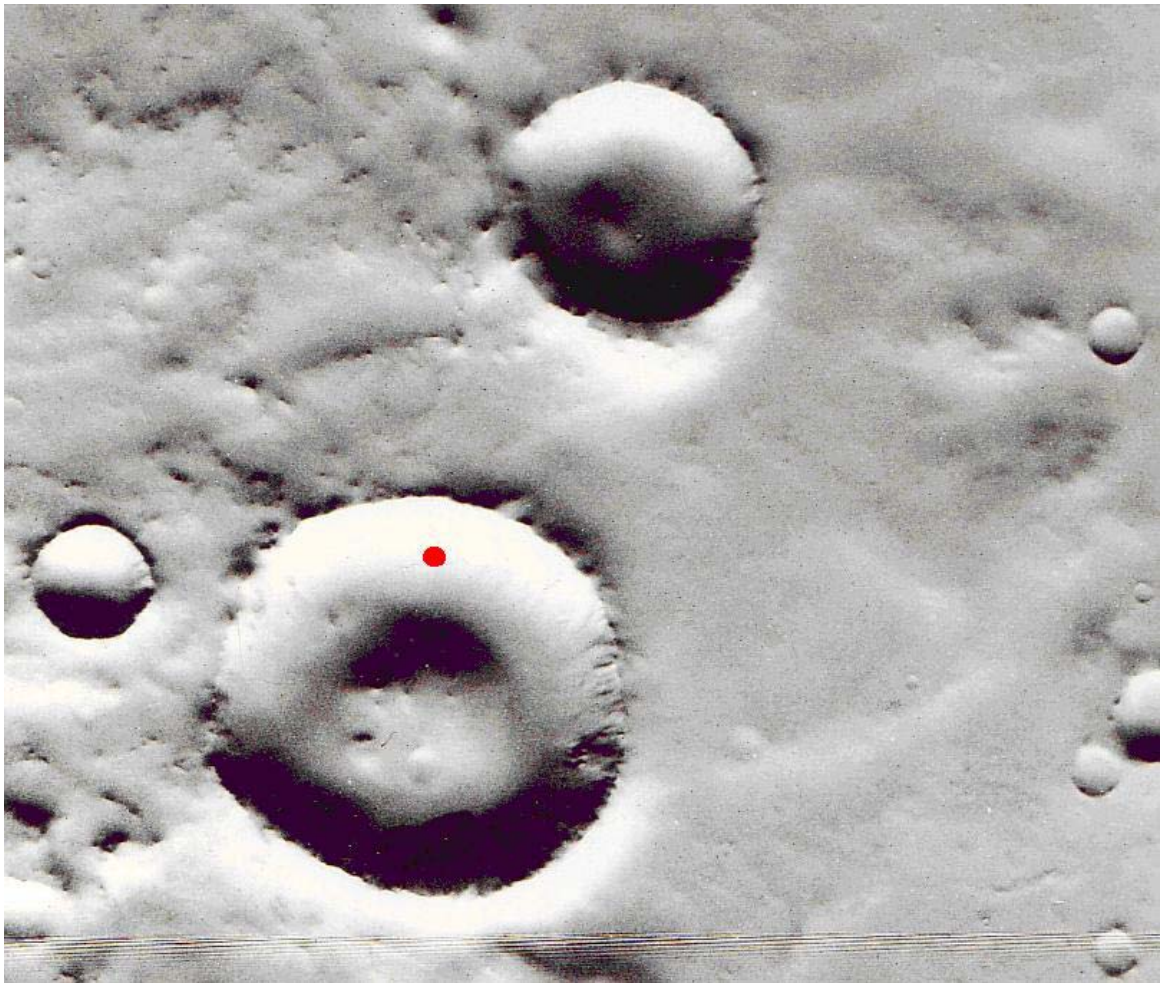
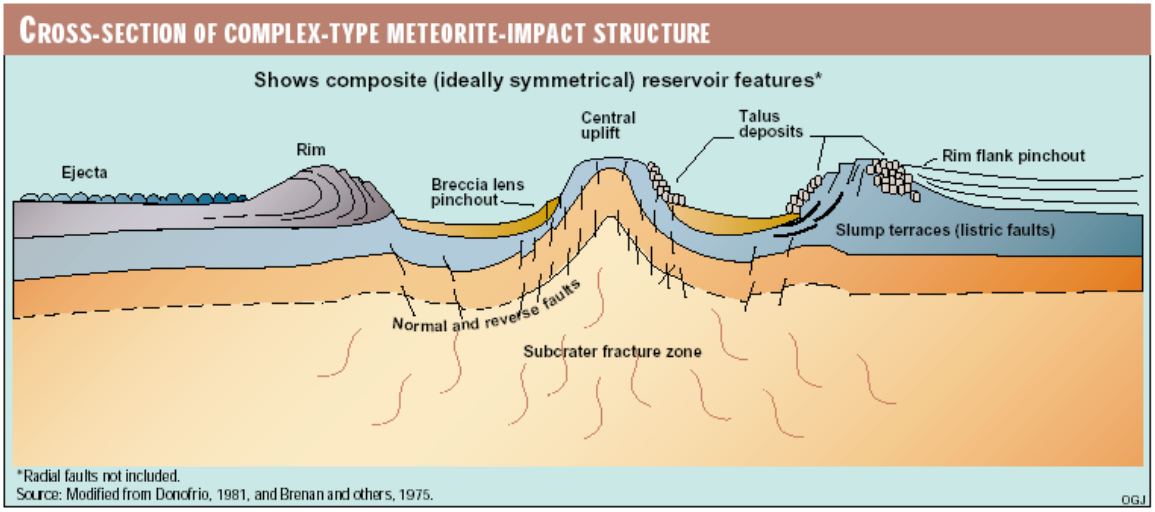


Figure 2. Viking Orbiter image of mars showing a complex-type impact crater. Panther Mountain is larger but has a similar configuration. Note the central uplift, which defines this class of meteorite craters (also called astroblemes). A simple-type crater having a distinct bowl shape is shown in the crater to the left. Structures like these on earth cannot create oil and gas, but they can create reservoirs in which oil and gas can accumulate. The red dot shows the approximate position of the Herdman well in the Panther Mountain structure. The well did not penetrate either of the two prime areas for hydrocarbon reservoirs – the rim and central uplift.



Oil and Gas Journal

Figure 3. Cross section of a typical complex-type impact crater, similar to Panther Mountain, showing the various reservoirs for oil and gas. In addition to the disrupted rocks of the crater itself, impact events occasionally display a circular ripple zone extending radially outward from the crater into the surrounding rocks. Under optimum conditions with sufficient source rocks, this ripple disruption can enhance the ultimate reservoir volume of craters.

Using existing geological and geophysical profiling at Panther Mountain and parameters from known hydrocarbon-producing impact craters, the estimated gas-in-place capacity for Panther Mountain approaches 80 billion cubic feet. This is a significant amount of gas, and recovering it would not require horizontal drilling and hydraulic fracturing because of the shattering effects of the meteorite on the target rocks. Natural impact fracturing far exceeds artificial fracturing and stimulation.

Hydraulic fracturing has come under attack in New York state and elsewhere because of the potential (real or not) for contaminating aquifers and surface waters. Fracturing shales to release gas in commercial quantities often requires the use of millions of gallons of water and numerous chemicals, the improper treatment and discharge of which can affect surface waters. But hydraulic fracturing would not be used for the Marcellus Shale or other formations at Panther Mountain, and there would be no harm to aquifers or surface waters.

However, another obstacle arises, and this one surpasses the hydraulic fracturing issue. State land covers the gas-prolific central uplift, and deviating wells under state land from private property within the Catskill Park – in this case to reach the central uplift – is not permitted. It would require a change to the New York State Constitution involving two sessions of the legislature, according to the attorney general's office. This unusual situation arises because the Devonian meteorite impact (~375 million years ago) occurred in an area that later became the Catskill Forest Preserve, which is within the Catskill Park. This Park was created back in 1885, and in 1894 the New York State Constitution was amended to read *"…the lands of the State now owned or hereafter acquired, constituting the Forest Preserve as now fixed by law, shall be forever kept as wild forest lands. They shall not be leased, sold or exchanged, or be taken by any corporation, public or private…"* The area has since been expanded and now constitutes approximately 300,000 acres. The courts have

ruled against mining beneath this area, and the same could be expected for a deviated wellbore, which would extract gas from beneath state lands.

Assuming the highly unlikely scenario where the constitution was changed to allow drilling, both the New York State Department of Environmental Conservation and New York City Department of Environmental Protection would take over. Panther Mountain lies within the Catskill/Delaware Watersheds, and this is a major source of New York City's potable water (Figure 9). Both agencies, along with the Mayor of New York City, have already raised concern about any drilling in the watershed area, and pending legislation would prohibit drilling within 5 miles of the boundary.

Lastly, if a green light were given then, according to an official at the attorney general's office, "the outcry would begin". So there you have it – a major potential source of gas located right beneath places in need, from private parcels and town lands through numerous surrounding hamlets. And the odds are that none of this gas will ever make it to the surface.

Shandaken, NY Assessor's Office

Figure 4. Assessor's plat of Panther Mountain area showing private (white) and state-owned land (green). The town of Shandaken and hamlets (population ~3,300) border the feature. Note the circularity of the crater shown by the private parcels. Due to restrictions on deviating wells under state property in this area, only vertical wells on private and town lands could be drilled for gas, if allowed. The rim of the crater could be penetrated by vertical wells. Red Dot - Herdman well; Blue Dot - Menla Mountain Retreat; Black Circle – outline of the underlying central uplift of the crater.

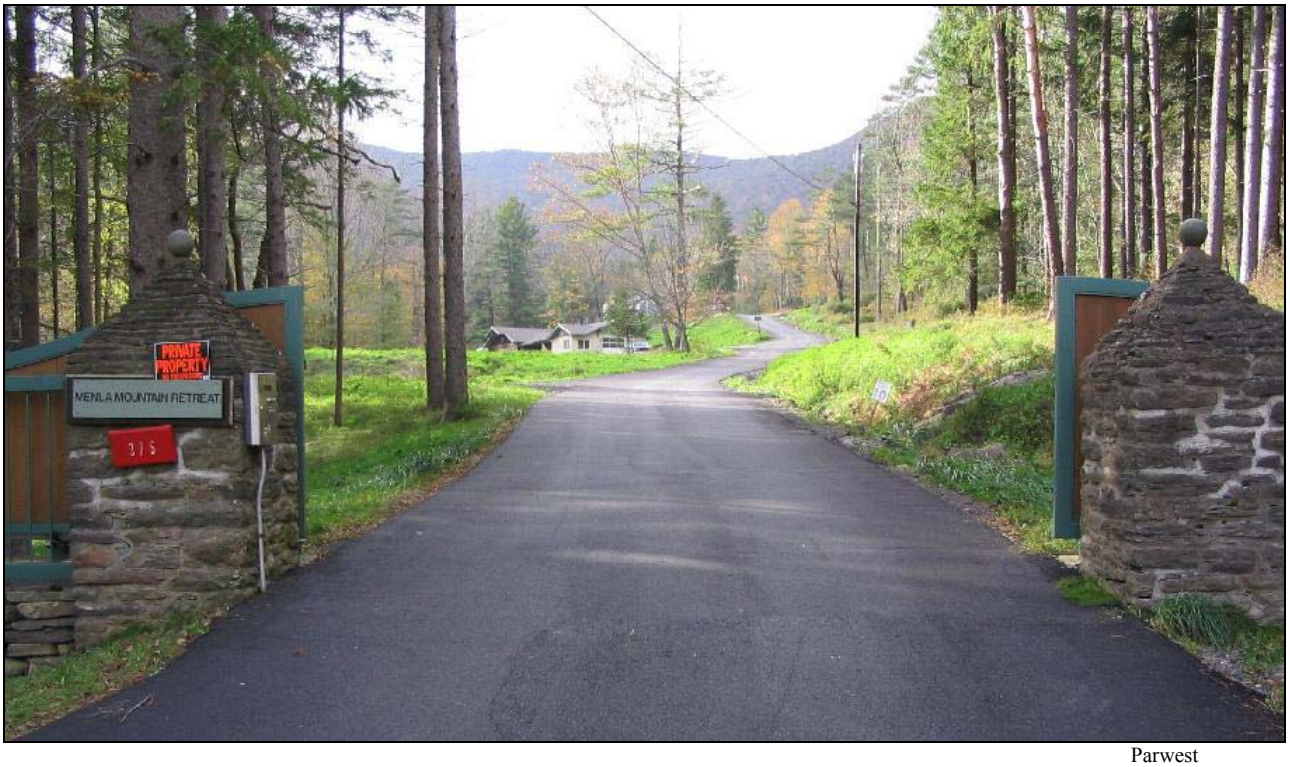


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Figure 5. Entrance to the Menla Mountain Retreat in the Catskills. Menla is on the east flank of the crater's central uplift and, with 310 assessed acres, is the largest block of privately-held acreage within the structure. This would be the key area for deviating a well to reach the central uplift, which is the most gas-prone part of the crater usually containing over 75% of the reserves. Expected gas production rates could be in the millions of cubic feet per day and would rival or exceed horizontally drilled and hydrofraced wells elsewhere. Menla is operated by the House of Tibet in New York City and was reportedly founded under the auspices of the Dalai Lama.

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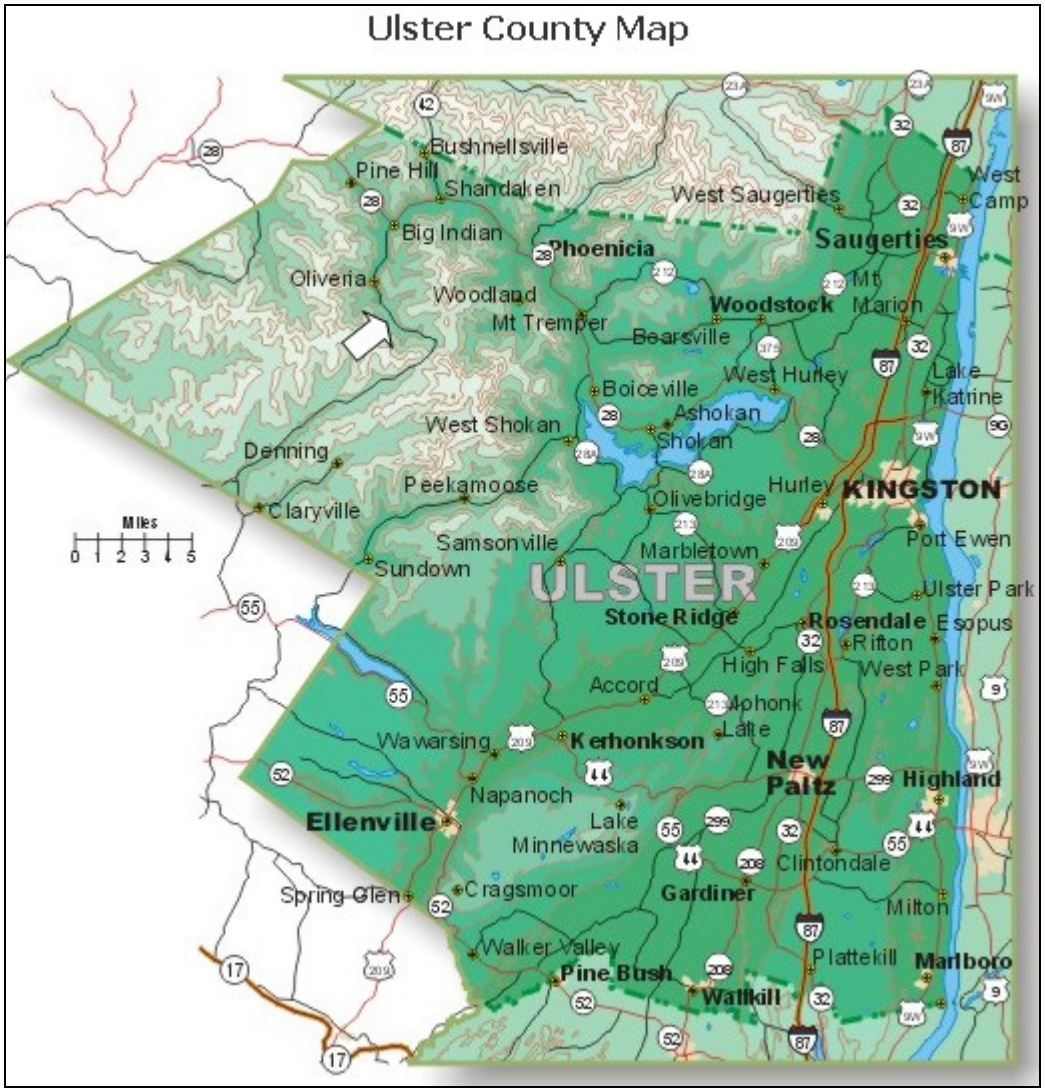
Figure 6. A section of the rim's Esopus Creek (looking southeast).

GPS: 42.101667N 74.383611W Parwest

Figure 7. The Herdman # 1 well drilled by Dome Oil and Gas Company to a total depth of 6,400 ft. The wellhead on this plugged and abandoned well is in good condition considering over 50 years of exposure, and the borehole could undoubtedly be reentered with little mechanical difficulty. The well was positioned in this area because the convex shape of Panther Mountain was thought to be caused by gas pressure at depth forcing the rock formations to bulge upward. The Herdman property appears to have been one of the better locations for drilling without encroaching on state lands. However, if Dome had known that they were drilling into a meteorite-impact crater, they could have penetrated the gas-prone crater rim by moving the location farther to the north. Mostly all of the homes in this area are heated by fuel oil, propane, and wood despite the abundance of natural gas below. A "neighborhood" gas well having a modest flow rate like the Herdman could supply the annual needs of at least 100 homes for 15 years or longer. Higher flow rates on new wells would be necessary to be viable and could sustain thousands of homes. Unfortunately, even vertical wells on one's own property would not be permitted here.



Hudson Valley NET

Figure 8. Map of Ulster County, New York. The approximate rim area is outlined by a road, which partially circles Panther Mountain (arrow).

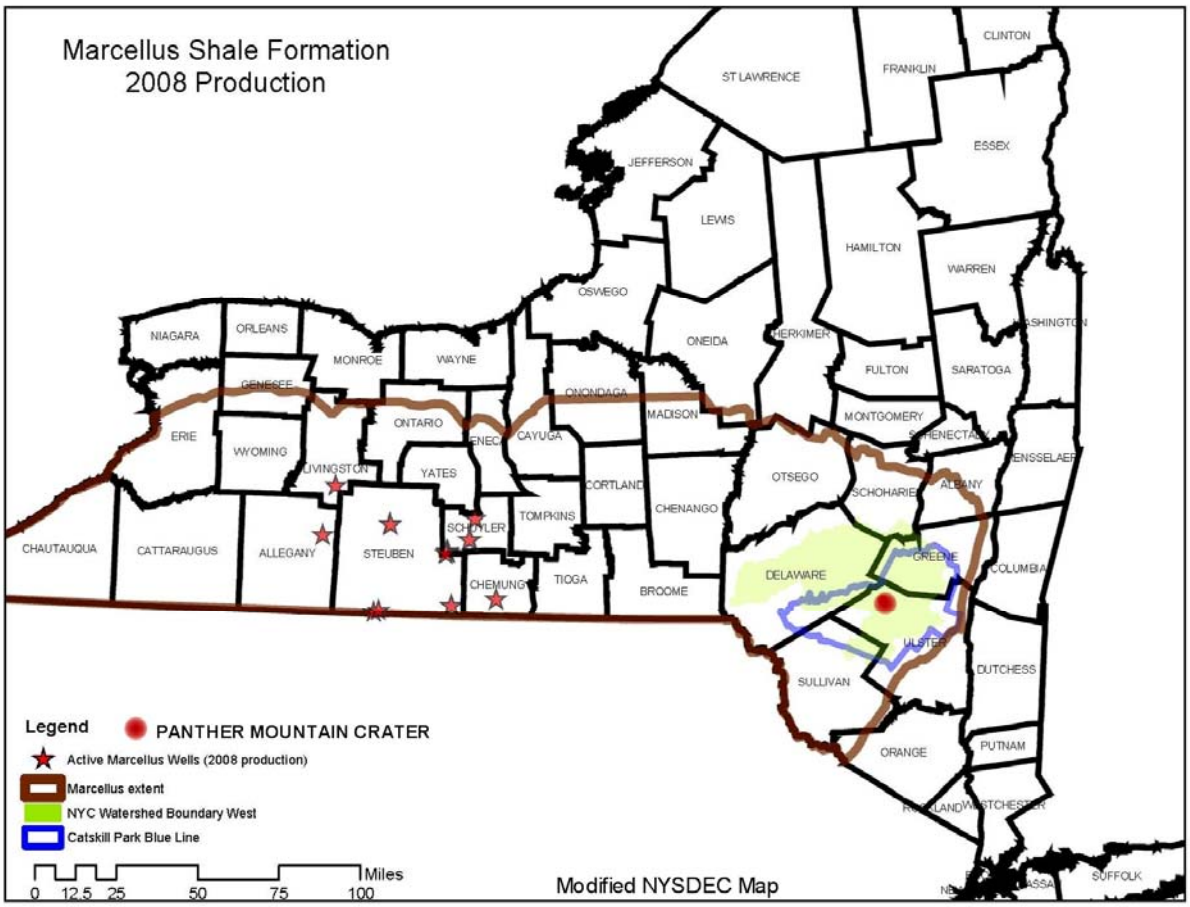


Figure 9. Location of the Panther Mountain crater relative to the Marcellus Shale, NYC Watershed and Catskill Park Boundaries. Note that the structure lies within all three. About 60% of the park lands are privately owned, with a population of ~ 50,000 year-round residents.

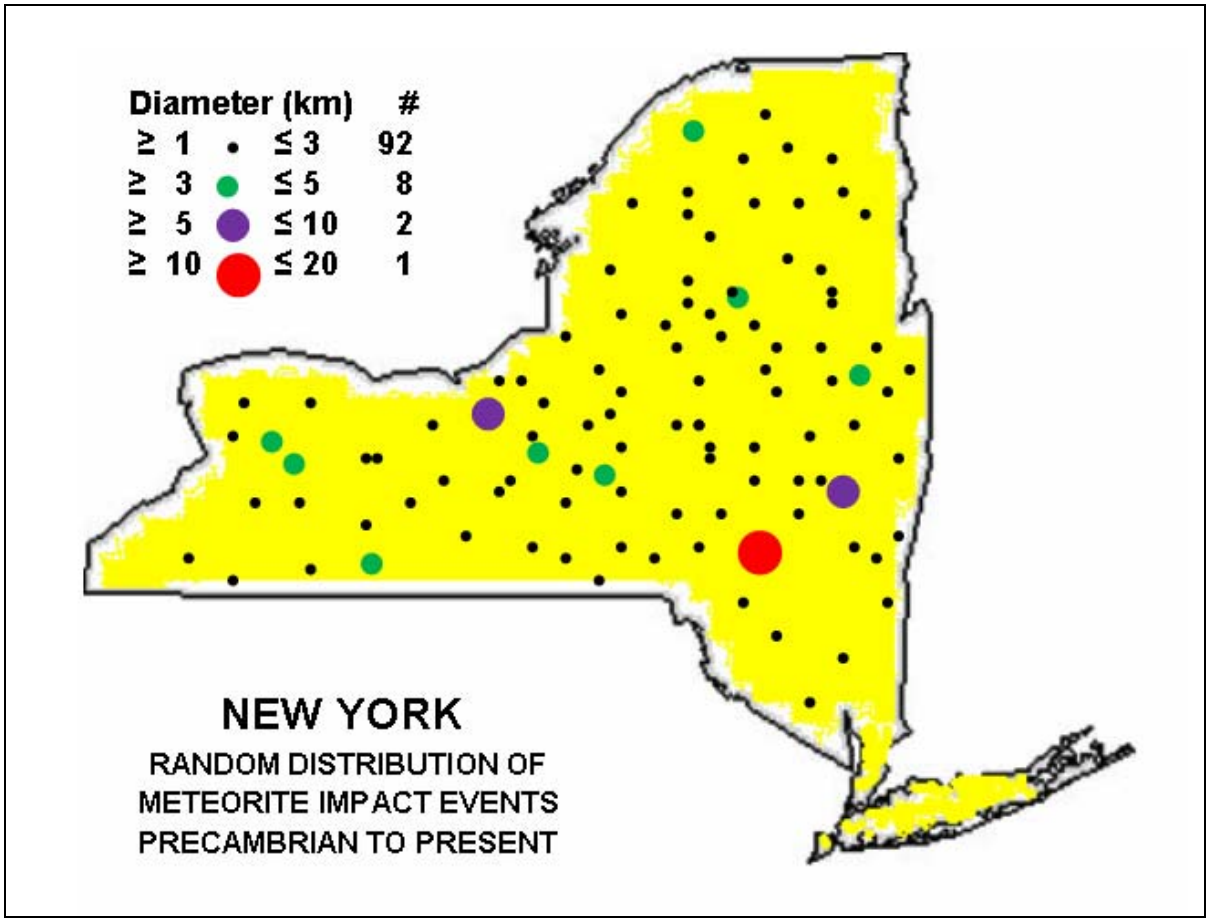


Figure 10. Random distribution of impact events since the Precambrian for New York state. Only the location of one, Panther Mountain (red dot), has been recognized to date. Of the ~103 predicted impact structures with various diameters, the timing of about 20 % would have affected the Marcellus Shale and other sediments capable of generating hydrocarbons. The craters that are hydrocarbon bearing would not require horizontal drilling or hydraulic fracturing for commercial production.

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Ames Structure in Northwest Oklahoma and Similar Features,1995 Symposium, Oklahoma Geological Survey Circular 100, 1997, K. Johnson and J. Campbell, eds. 396 pgs.

Other references and web links below.

Links to Additional Articles and Websites

The late Ingvar Isachsen studied Panther Mountain for over 30 years. The article below discusses Panther Mountain and some of his work
The Panther Mountain Crater | Meteors, Asteroids, & Comets | DISCOVER Magazine
http://discovermagazine.com/2000/aug/featcrater

Aerial photos and additional studies of Panther Mountain
Odale-Articles-PantherMountain - OttawaRasc
http://ottawa-rasc.ca/wiki/index.php?title=Odale-Articles-PantherMountain

Other publications by Ingvar Isachsen
http://www.nysm.nysed.gov/staffpubs/index.cfm?category=Geology

Discussion of meteorite impacts on earth
Traces of Catastrophe
http://www.lpi.usra.edu/publications/books/CB-954/CB-954.intro.html

Articles related to oil and gas production in meteorite-impact craters
http://www.parwestlandexploration.com/docs/og.pdf

http://www.parwestlandexploration.com/docs/jpgart.pdf

Oklahoma Today Magazine, Star Wound – The Ames Crater
http://www.parwestlandexploration.com/docs/StarWoundOklahomaTodayMagazine.pdf

The Ames Astrobleme Museum
http://amescrater.com/