

# **Opinion: Sulfides and Uranium in Michigan** *Addressing Popular Myths and Misconceptions*

Shawn M. Carlson  
P.O. Box 24  
Norway, Michigan 49870

The state of Wisconsin has a proud mining history. From the historic lead/zinc mines in the state's southwest to the iron mines of its north, much has been written of Wisconsin's mineral wealth and its role in the development of our nation (LaBerge, 1994). So when strong opposition to mining emerged in northern Wisconsin in the 1980's, I think many of us Michigan geologists looked on with a mix of bewilderment and pride—bewilderment at the perplexing inanities unfolding in Wisconsin's emerging anti-mining industry, admixed with pride at our pro-mining Michigan next door; that somehow our earth science education must be better than Wisconsin's, such that the good people of Michigan would never fall for the tactics of "big environmentalism", which some authors have accused of fraud, or likened to a cult (Huston, 2002).

Well, we were wrong. In the past few years, a strong anti-mining presence has developed in the Upper Peninsula ("U.P.") of Michigan, focused primarily upon Kennecott Minerals "Eagle" project (a proposed nickel/copper "sulfide" mine in Marquette County) but equally opposed to pretty much all other mineral exploration as well. And maybe that's not all bad. Mining can be a messy business. And like any big business, mining carries the potential for greed and corruption, so the more regulation and critical public oversight, the better. But this same philosophy applies to environmentalism, which is also big business, capable of greed and corruption (Coffman, 1994).

The model that has developed in the Northwoods is a far cry from genuine environmental protection. What happens is that a mineral company sets up shop and starts exploring. Local residents welcome their presence and the money that explorers spend in their community. All is well until the company develops an advanced project that could be brought to the mining stage. Wealthy, nationally-recognized, "big environmental" groups take note and start to draw local attention to the possible new mine by spreading false information to the general public. "Big environmentalism" knows that like religious affiliation, most people do not change their views on mining once they have been made; so by engaging in disinformation blitz campaigns heavy and early, "big environmentalism" guarantees a stable, local base of anti-mining activists.



Friend or foe? A beautiful 0.3 cm cubanite (copper iron "sulfide") crystal from Marquette County, Michigan—locus of both an emerging nickel copper exploration and mining industry, and an emerging anti-sulfide-mining "pop environmentalism" industry. (Photo by Dr. John A. Jaszczak).

Local sportsmen are specifically targeted, told that unless they help "Stop the mine!" that their prime fishing and hunting grounds may be destroyed. Sensational "grass roots" websites follow, with dubious information posted in mock "press releases" on an almost daily basis and with impunity, since at the present time, there is no legal regulation of anti-mining "press releases" to ensure the accuracy of their contents. It's a big business, dubbed by one ex-Greenpeace member as "pop environmentalism": the use of, "sensationalism, misinformation, fear tactics, etc. to deal with people on an emotional level rather than an intellectual level" (Moore, 2008). It's very profitable. And it can be very scary: the Marquette County, Michigan "Hazard Mitigation Plan" lists ecoterrorism against mining companies as one of its concerns for the county, and cites the attempted bombing of nearby Michigan Technological University by "ELF" (Earth Liberation Front) eco-terrorist Ian Jacob Wallace as an example of what can—and does—happen when environmental

activists put their "sensationalism and fear tactics" into overdrive (Young, 2008). Pop environmentalism detracts from real environmental science that needs to work with the mining industry, in order to mitigate environmental damage from the pursuit of earth commodities we all use ([www.mii.org](http://www.mii.org)).

But perhaps the greatest casualty of the pop-environmental, anti-mining industry is science itself. As a scientist, if I am asked to assess the impact of three abandoned mine sites, I must examine the sites objectively. If I find that all three are polluting, then that's what I report. If none of the sites are polluting, then I report that instead, with neither passion nor prejudice.

But the goal of the anti-mining industry isn't dispassionate scientific research, but to "Stop the mine!". Like any radical politic, anything that forwards the goals of the organization is defined as "good", and anything that detracts from those goals is defined as "bad." Hence, the anti-mining industry likes emphasizing environmental damage caused by mining ...but what about all of the world's mine sites that are causing no apparent harm to anything? There is little mention of safe mining practices or successful reclamation because these facts don't serve the anti-mining agenda. Science isn't a friend to the anti-mining industry, because science stresses the full reality of global mining history—the messes and successes.

In Michigan, this degradation of science is manifested by slogans and "one liners" that are being parroted from one anti-mining group to the next. They are presented below, each with a critical assessment and response.

But before we begin, as author, I appreciate that this article is a bit different from most appearing in Mineral News, such that a mineral collector in (say) Florida or Maine might wonder just why they should finish reading this article—one that appears to deal with local, Michigan politics. I would offer that this essay has less to do with local politics than with a general malaise in earth science education throughout the United States. What's happening in Michigan is a prime example of what can happen (anywhere) when our educational systems fail to stress earth science—that in this informational vacuum, whacky-doo, web-based "pop environmental" groups spring up and take over the teaching of sham earth science where valid science education has left off. In Michigan, there have already been cases of students afraid to even touch beautiful pyrite crystals (fools gold) because they've been told it's "dangerous" and "acid"! The societal cost of this breathtaking insanity is still beyond estimate—who's to say that left unchecked, that all minerals may not one day be banned from our classrooms, under some misguided guise of "safety"! And if so, what of future mineral collectors—and major shows like Denver and Tucson? Bottom line: if we, as earth scientists, do not stand up for our discipline, then someone else will. Whether we like it or not.

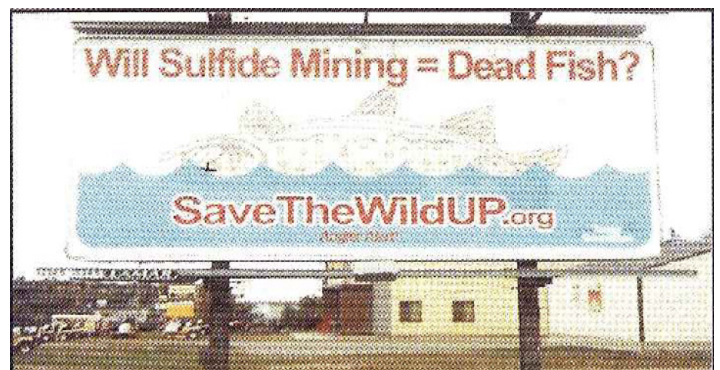
**What is "sulfide mining"?** (Source: various).

The term "sulfide mining" is slang. It is not a scientific term. No mention of it appears in the *Geology of Michigan* (Door and Eschman, 1977), the *Mineralogy of Michigan* (Robinson,

2004), nor *Geology of the Lake Superior Region* (LaBerg, 1994). It is preferred by anti-mining groups (and the sensational media) for a reason: it confuses people. And that's good business for the anti-mining industry, because the more people can be confused, the more they can be frightened into signing petitions and donating money. How does this tactic work? Well, consider water. If one were to circulate a petition declaring that 'water' should be banned, I don't think many signatures would be forthcoming! But refer to water by its chemical name, ("dihydrogen monoxide") a name unfamiliar to the general public, and watch protestors sign right up.

The same is true for "sulfide mining." Sure, as all collectors know, some minerals are known as "sulfides" by their systematic Dana classification. Copper, for example, can combine with sulfur to form sulfides like chalcocite ( $\text{Cu}_2\text{S}$ ). Copper can combine with oxygen to form minerals like paramelaconite ( $\text{Cu}_1^{+2}\text{Cu}_2^{+2}\text{O}_3$ ). Or it can combine with silica to form minerals like chrysocolla ( $\text{Cu}^{2+}, \text{Al})_2 \text{H}_2\text{Si}_2\text{O}_5 (\text{OH})_4 \cdot n\text{H}_2\text{O}$ ). It can combine with halogens to form minerals like atacamite ( $\text{Cu}^{2+} \text{Cl}(\text{OH})_3$ ). There is one abandoned mine in Michigan where all these copper minerals have been reported (Carlson et al., 2004). So what should the mine be called? By mineral name, it would be a "chalcocite-paramelaconite-chrysocolla-atacamite" mine (hideous). Or, by chemical class, a "sulfide-oxide-silicate-chloride" mine (equally hideous). But none of these technical names would be understood by the general public. So, the tradition of the minerals industry has been to refer to the target commodity: it's a copper mine. This tradition is as old as mining itself (Job 28:2; Deuteronomy 8:9\*) and represents an ethical responsibility to use language to inform people—not confuse them. [\*Note: Deuteronomy 8:9 (NAV) is a particularly fitting reference, in how well the verse seems to describe northern Michigan: "...a land whose stones contain iron and in whose hills you can mine copper."]

But as the anti-mining industry is aware, it's difficult to get people to protest "copper mining" for two reasons: first, it's familiar (people know what copper is) and second, it's desired (people know copper is needed). But by referring not to the metal ("copper") but instead to the non-metal ("sulfide") and inventing a new slang term, "sulfide mining", it's easy to get people riled up; not only does the term sound "chemical" (icky) but most people simply don't know what a "sulfide" is, and this lack of understanding is a convenient "fright point" that the anti-mining industry takes ready advantage of.



Science or scare tactic? An anti-mining billboard in Marquette County, Michigan. (Photo by Shawn M. Carlson).

## Ban Dihydrogen Monoxide!

### This dangerous industrial chemical:

- Causes more deaths in the United States each year than cyanide;
- Is used by the nuclear industry;
- Is present in detectable amounts in our food;
- Is even in our drinking water!

*Please help us ban this dangerous industrial chemical now!*

Sign me up? A variant of the popular “joke petition”, asking people to help ban drinking water by referring to it by its less-familiar chemical name, “dihydrogen monoxide.” The same tactic serves the anti-mining industry well-by changing familiar names like “copper mining” or “nickel mining” to unfamiliar, chemical-sounding names like “sulfide mining”, the anti-mining industry continues to thrive in the Northwoods. (Text by Shawn M. Carlson).

### What is “acid mine drainage”? (Source: various)

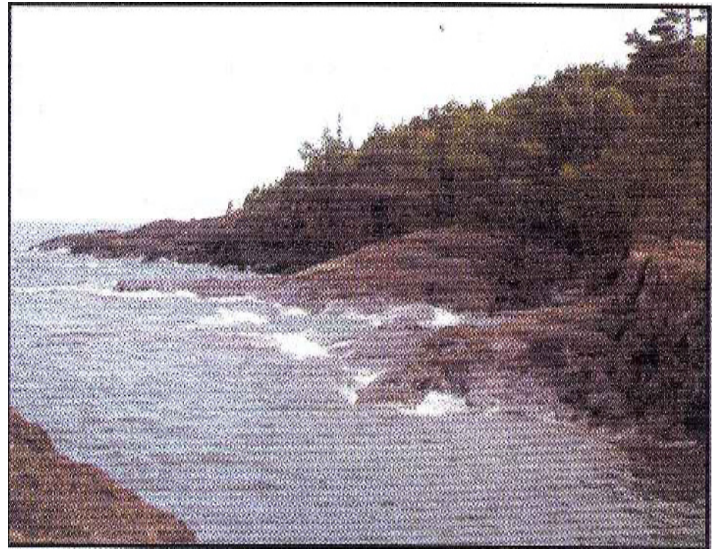
The term “acid mine drainage” is also somewhat slang. It attempts to describe the process by which abandoned mines can release acids into the environment. Although the sulfide anion ( $S^{2-}$ )<sub>aq</sub> is actually a pretty strong base (not an acid) and most sulfide minerals have no effective basicity (or acidity) because they are not very soluble ( $Cu_2S$   $K_{sp} = 2 \times 10^{-47}$ ), certain sulfides can undergo a complex sequence of reactions (probably both electrochemical and biochemical-e.g., Thiohaecillusferrooxidans) whereby they oxidize to form acids. As mineral collectors know, it is risky to invest too much money in marcasite ( $FeS_2$ ) since this mineral can crumble to acidic (sulfate) dust despite our best efforts at preservation. Excessive acid generation in abandoned mines can cause deleterious metals to leave their stable mineral structures and become water-soluble, contaminating rivers and groundwater. A good example is the Britannia mine in British Columbia, where acid drainage has led to the re-mobilization of copper at levels toxic to aquatic life in Howe Sound (Clague and Turner, 2006). The recognition of this problem has resulted in tighter regulations governing mining, requiring methods such as backfilling with limestone to neutralize acids that might be generated. In this fashion, mining isn't different from other industries like medicine (psychiatric patients once treated to “ice pick lobotomies”) or pharmacy (the thalidomide fiasco) that have had to improve upon their past mistakes as well.

However, the problem with the term “acid mine drainage” is two-fold. First, it implies that this acid generation is only associated with mining. That's false. The oxidation of sulfide minerals to form acids is a natural process that occurs throughout the world at many sites that have never seen mining. For this reason, the more appropriate term is “acid rock drainage”. Further, many anti-mining groups abbreviate their slang term “AMD”, which may be a deliberate (and distasteful) attempt to conjure up visions of “WMD”, a set of letters now well-engrained into the American psyche. Again, this “shock-and-awe” tactic is an example of “pop environmentalism”—the use of, “sensationalism, misinformation, fear tactics, etc.” (Moore, 2008).

### This type of mining is NOT our heritage!

(Source: [www.northwoodswildernessrecovery.org](http://www.northwoodswildernessrecovery.org))

Because the term “sulfide mining” is modern slang, many people have got the idea that we've never done it in Michigan before, because it's not mentioned in older references to Michigan's mining history. Yes, Kennecott's “Eagle” project will be the first time that Michigan has seen large-scale nickel mining, but we've been doing “sulfide mining” in Michigan for over a century. If we define “sulfide mining” as mining that targets sulfide ore minerals (or encounters significant sulfide gangue) with “acid generating potential”, then most types of mining in Michigan history (e.g., Cu, Au, Pb/Zn/Ag, Fe, graphite, coal) could be called “sulfide mining.” Just a few examples of former Michigan “sulfide mines” include: the Cops, Nonesuch, White Pine (one of the largest “sulfide mines” in North America), Holyoke, Ropes, Buck, Groveland, South Taylor, and Consolidated Coal mines (Robinson, 2004). The last is particularly interesting; Robinson (2004) states that the, “waste pile of the coal washery contained several thousand tons of lump pyrite [= reactive sulfide]. It was investigated as a possible source of sulfur during World War I”.



Forgetting something? Some anti-mining groups claim that “sulfide mining” has never been done before in Michigan; that if allowed, it will damage Michigan rivers and Lake Superior; that it will hurt tourism; and that Native Americans are conscientious objectors to this form of mining. Yet in the northeast cove of Presque Isle City Park in downtown Marquette, there are remains of small-scale copper/nickel “sulfide mines” from the late 1800s. These sites are causing no apparent environmental harm, haven't hindered tourism in the slightest, and according to Brooks (1873) the mines were begun after “Indians and traders” became aware of the peridotite-hosted Cu/Ni sulfide veins and their potential to carry gold and silver—thus suggesting that Native Americans were perhaps the first “sulfide miners” in Michigan.

### There has never been a metallic sulfide mine that has failed to pollute its watershed. (Source: [www.savethewildup.org](http://www.savethewildup.org))

Mining, like other industries, is well-described on a bell curve (statistics). On one “3 sigma, and maybe even 5” fringe, there are a few mines that have caused immense damage to the environment. Then, as one approaches the bulk of the curve from the left, we encounter many mining operations that have produced modest environmental damage; then on to the other side of the curve where many mining operations have caused little or no environmental damage, finally to the “3 sigma, and maybe even 5” fringe on

the far right side of the curve where a few mining operations may (?) have actually improved the environment.

In Michigan, there are many abandoned "sulfide mines" that are causing no apparent damage to the environment.

**Sulfide rock mining unlike iron mining, can produce, sulfuric acid.** . . . (Source: www.wsn.org)

To the best of my knowledge, there are only a few sites in northern Michigan where acid rock drainage is occurring in amounts sufficient to damage the local environment—and all of them are abandoned iron mines. Unlike magmatic Ni/Cu sulfide deposits (e.g., Eagle) or VMS deposits (e.g., L-K/Back 40) where the sulfide minerals are extracted as ore, the reactive sulfides encountered in iron mining are viewed as waste—and left in underground stopes and open pits (or waste rock piles) where they can decay to release acids (and toxic heavy metals) into the environment. Acid drainage from abandoned iron mines has already damaged Michigan rivers, as well as city infrastructure (Johnson, 1994). That some anti-mining groups state that iron mining "does not produce acid drainage" is yet another indication of the lack of minerals savoir faire within these groups.

**Area physicians pass resolution opposing sulfide mine.** (Source: www.savethewildup.org)

Several years ago I ran a mineral exploration program in western Wisconsin. After a long, hot day I checked into a hotel, and found a sign in the room—stating that the water was "contaminated by nitrates" and "not safe for children." Unbelievable—part of Wisconsin's ground water supply poisoned, but not by mining—by farming (nitrates). Yet I did not see anyone protesting farming. The Iron Mountain, Michigan Daily News ran a story (AP) on March 10th, 2008 stating that, "a vast array of pharmaceuticals-including anti-convulsants, mood stabilizers and sex hormones—have been found in the drinking water supplies of at least 41 million Americans." That's frightening. Why don't I see picket signs outside hospitals, protesting doctors, pharmacists, and excessive drug sales? I think Tony Nikischer hit on the answer in an essay entitled, "American Education System Flunks Geology Usefulness Exam" (2007). Whereas other countries have maintained a high standard of earth science education, we have largely abandoned it. Unfortunately, this death of earth science knowledge is occurring at the same time when concerns about the earth (e.g., "global warming", "sulfide mining") are front-and-center in our politics. This paradox sets up an unfortunate situation where many well-meaning professionals (e.g., doctors, nurses, biology professors) engage in knee-jerk, anti-mine protesting, for the simple reason that they lack sufficient earth science training to know what a proper, constructive response should be. Sure, I'm concerned about mining damaging the environment. But I am equally concerned about farming's fertilizers and livestock antibiotics; medicine's nosocomial infections and "big pharmacy"; and even the immense shopping centers that we all seem so desperate to build ever more of—obliterating beautiful trees, fields, and wildlife habitat in the process.

**A significant byproduct of this mining technology is sulfur, which forms sulfuric acid when it comes in contact with water.** (Source: www.sweetwatervisions.com)

Ugh. Perhaps someone needs to write an essay entitled, "American Education System also Flunks General Chemistry Usefulness Exam"?

**Sulfide mining should be banned.** (Source: various)

Careful; without a more precise definition of "sulfide mining" than what the Michigan anti-mining industry typically uses, such a ban, might prohibit all future mining in the state of Michigan—because "acid producing" sulfides can theoretically be encountered in just about every type of mining there is. But would the ban stop there? Some gravel pit operations encounter reactive sulfides. Would gravel pits be censured under a "sulfide mining" ban? How about highway development? There's a stretch of highway near the Peshekee River (Marquette County) where sizeable quantities of acid-generating sulfides (along with anomalously radioactive rock) were encountered—and excavated—during road construction. Would highway improvement be hindered under a proposed "sulfide mining" ban? If not, then why not?

**With over a dozen additional proposed sulfide [and uranium] mines, the U.P.'s most pristine and unspoiled lands are currently in serious danger.** (Source: "Students Against Sulfide Mining" 2008 calendar; brackets added)

A "proposed mine" is a matter of fact and record. First, you need a viable orebody to mine (the scientific fact component) and then you must propose to mine it, by way of permit applications (the public record component). At present (October 2008) there is only one "proposed sulfide mine" in Michigan; three, if we are generous with our wording. All other sites are merely "exploration projects" where geologists are searching for, or drill-testing, anomalous mineralization (or geochemistry). As anyone who has worked in the industry knows, the odds of any single "exploration project" discovering a mineable orebody are around ~ 1%.

**Michigan needs to take the threat of uranium mining in the Upper, Peninsula seriously.** (Source: God's Country U.P. Outdoor Magazine, vol. 2, issue 12, Dec. 2006\*\*)

In his preface to the Mineralogy of Michigan (1976; 2004), the world-renowned mineralogist and uranium expert Dr. E. William Heinrich (heinrichite,  $Ba(UO_2)_2(AsO_4)_2 \cdot 10-12H_2O$ ) made no mention of uranium deposits (sensu stricto) in Michigan, for two reasons. First, because there has never been any uranium mining in the state, and second, because decades of dedicated uranium exploration in Michigan have resulted in the discovery of pretty much squat, save for a small handful of minuscule, uranium-bearing "prospects" (Carlson et al., 2007) that are so tiny that they could not possibly be mined even if uranium reached precious metal values. Michigan simply lacks uranium deposits, (FrondeL, 1958; Lauf, 2008) and you can't mine what you haven't found. (MDNR and MDPH, 1982). [\*\*Science or sensationalism? This issue contains an article on uranium exploration in Michigan—immediately preceded by an article on Bigfoot!]

**Although uranium is not yet being mined in the U.P., exploration of uranium ores can cause health risks to communities.** (Source: The Splash, Nov./Dec. 2008)

Sure it can—if not done properly. Water wells can cause health risks to communities, too—if not drilled properly. Underground gasoline storage tanks can cause health risks to communities—if not maintained properly. That's why we have strict laws regulating drilling and other underground activities. But insinuating that exploration of "uranium ore" in Michigan can cause health risks is irrelevant. The term "ore" is an economic expression, designating a sizeable mineral deposit that can be extracted profitably at current market conditions. Michigan does not have any uranium ore. So why are anti-mining groups protesting something that we don't even have in the first place? Could this be an example of "pop environmentalism": the use of, "sensationalism, misinformation, fear tactics, etc. to deal with people on an emotional level rather than an intellectual level" (Moore, 2008)? And who writes these "warnings" about uranium ore, anyway? Are they written by degreed, highly-trained geologists and environmental mineralogists who have spent their careers working around uranium/thorium minerals—or by amateurs who have probably never even seen a piece of uranium ore (let alone owned a fine cuprosklodowskite) who are downloading junk pseudoscience from "the web", then regurgitating it into yet another (sigh...) sensational tabloid rag?

**Soon Michigan will be able to lure tourists to the Upper Peninsula with the slogan: "The water's perfect and the sun never sets: We've warmed up Lake Superior with acid, and the warm glow of uranium make [sic] the day last forever."** (Source: www.urth.tv)

Again, "pop environmentalism": the use of, "sensationalism, misinformation, fear tactics, etc. to deal with people on an emotional level rather than an intellectual level" (Moore, 2008).

**Vacation in Michigan's Upper Peninsula now-before it's too late-soon you won't want to visit.** (Source: a www.urth.tv article entitled, "The Northern Michigan Death Knell: A Funeral For Tourism, Clean Water, Pristine Forests.")

And again, "pop environmentalism": the use of, "sensationalism, misinformation, fear tactics, etc. to deal with people on an emotional level rather than an intellectual level" (Moore, 2008).

**Mine opponents just want to help protect the environment.** (Source: various)

I do hope so, but I don't see how emotional outbursts in public hearings, or angry protest banners, help anything. Nor does it help to send letters to government agencies protesting "sulfite" or "acid" mining; we can't expect regulatory agencies to act on letters that contain ridiculously poor-quality information. So what to do instead?

The first step in genuine environmental protection is to show people what they stand to lose if the environment is not protected. Many children in inner-city settings rarely get to appreciate the wilderness that so many of us in the Northwoods can so easily take for granted. Every dime spent on "wilderness experience" programs for urban schools is a great in-

vestment in our future. Once children learn to appreciate the environment, the next step is to equip them with the tools to protect it—and that means science. Encourage students to develop a healthy interest in earth science, but "sans" politics. One demo I have run in recent years is to take some "ugly rocks" into the classroom, then turn out the lights and show their beautiful fluorescence and triboluminescence; end the show with treats of triboluminescent wintergreen LifeSavers® and students are left with a vision of earth science as beauty and play—encouragements to study the Earth further.

For students who are more interested in arts or music than science—that's wonderful. Nevertheless, I suggest that our education system is failing you in its inability to stress the difference between peer-reviewed science and politicized "junk" science. Huston (2002) lists six reasons even brilliant scientists can start peddling pseudo-science (money, fame, national/ethnic pride, religion, romanticism, psychological instability). Learning the difference between science and someone else's "agenda" can protect you from being taken advantage of—even if you have no interest in pursuing a science career yourself.

For college students already neck-deep into the anti-mining movement—a suggestion. Your politics are your own, but I assure you that a potential employer will be less impressed by, "I protested a sulfide mine" than by, "I protested a sulfide mine...but I also went to an abandoned sulfide mine, conducted water quality and mineral studies, and published my findings in a scientific journal." That's an instant hire, as far as I am concerned. A little less time protesting "sulfide mines" and a little more time studying them, may serve you well.

And for the die-hard, "anti-sulfide-mining" adults out there, who happen to be married, might I ask if you have a diamond ring upon your finger? The human rights violations, environmental, and economic damage caused by diamond mining are well documented, but unlike copper and nickel "sulfide mining", the sparkly "bling" of diamonds is vanity, pure and simple—and a clear case of environmental destruction in the name of unnecessary adornment of the human body. So how is it that you are simultaneously protesting a type of mining that is necessary, (try getting along without copper) yet are supporting a type of mining that is not (gemstones)? Familiar with the acronym, 'N-I-M-B-Y'?

Yes, yes, I know. Send me your angry letters. Because that somehow helps the environment too.

**Shawn M. Carlson** is a 1991 graduate of Michigan Technological University (geology) with additional background in biology (pre-medicine). He has worked extensively in mineral exploration (particularly in the Northwest Territories and Nunavut) and served as the senior mineralogist of Ashton Mining of Canada Inc. from 1995-1999. Mr. Carlson re-opened the Indiana copper mine (Michigan) in 2002 as a specimen mining venture; is a contributing author to the *Mineralogy of Michigan* (2004; 2008, in prep.) and is the recipient of the 2007 "Best Article of the Year Award" (Friends of Mineralogy society) for a study of Michigan uranium mineralization. Mr. Carlson has also assisted in the study of acid rock drainage in Michigan (in collaboration with Hope College). In 2005, he established the "Shawn M. Carlson Scholarship" to fund student research in mineralogy.