Improvements to geothermal energy production

Geothermal energy is not easily accessible with our current technology.

Our main focus was to figure out methods of harnessing this energy with new innovations based off of current technologies. These improvements would help improve our technology capabilities and be able to achieve what we never accomplished before. One problem with geothermal energy is an inadequate supply of magma sources. Magma chambers only exist depending on certain factors such as temperature and pressure along the geothermal gradient. Peridotite solidus plays a key role in this process. Peridotite is a dense rock that contains a large amount of olivine and it is located mainly in Earth??? s mantle.

Magma is created by partial melting of rock under high amounts of pressure and when the rock reaches a temperature between 600-1200 degrees Celsius. Once magma starts to form, it would be easier for more magma to generate because liquids can separate easily solids since liquids have a lower density. Forming magma synthetically is not as easy as it seems. The best humans can do to create magma is to stimulate more magma production. The three main methods of generating magma are by radioactive heat, frictional heat, and decompression due to convection.

Each of these processes has its own set of limitations. Basaltic magma is the most common type of magma and it has a low viscosity, which means it is able to flow freely. This low viscosity allows dissolved gasses to escape which prevents gas pressure from accumulating in magma chambers. Because of this, basaltic magma would be the most logical to generate and utilize. Raising the geothermal gradient would increase the formation of magma.

As mentioned before, it could be created by radioactive heat, frictional heat, and decompression due to convection. Radioactive heat is a result of radioactive decay. Sub-atomic particles are released during radioactive decay and these particles collide with other atomic particles. When they collide, the kinetic energy is converted into heat.

A possible source of radioactive is heat is the usage of nuclear explosive devices. The nuke would have to be placed at a depth of about 2 miles, which should be in the Earth??? s mantle. Nuclear explosion can potentially reach temperatures in the millions of degrees Celsius. This tremendous amount of heat has the capability of producing a lot of magma but the explosions are highly destructive to the surroundings. The high pressure produced by the explosions cause the cavity to expand to its maximum and then it would collapse.

It results in a rubble chimney. Depending on the strength of the explosion, the chimney could reach up to the surface and a crater would form. If the nuclear product gets released into the atmosphere, nuclear fallout would occur and that has a lot of hazardous effects. Another dangerous effect of the explosion is a possible trigger of a fault rupture which would cause a high magnitude earthquake.

If nuclear heat was to be used in the generation of magma, it would have to be used in small controlled quantities to limit the destructiveness of the blast. The other methods mentioned above proved to be unethical means of creating magma. Generating frictional heat would require rocks to rub against each other. This process already occurs naturally but if it is to be used as a major source, more rocks would have to be forcefully rubbed against each other. However, this is almost impossible to do because the creation of magma occurs in the mantle and that is a depth that current technology cannot yet reach. Also, disrupting the forces acting upon the already moving rocks could cause disruptions in the tectonic plates which would then lead to possible outbreaks of earthquakes.

Along the same reasoning, producing heat from convection has almost the same implications. Convection is when heat moves with the material. When the temperature gradient is higher than the material below it, the material would expand and become less dense. This creates an unstable situation and ??? the hotter, lower density material will rise to be replace by descending cooler material in a convection cell,??? (tulane.

edu). These decompressions allow magma to be produced. In order to induce the convection, additional heating would have to be applied and the only possible current method is heat from nuclear explosions. For these reasons, creating magma by synthetic means is not reasonable with our current technologies.

A possible future of magma generation is in the usage of nuclear explosions but these explosions must be minimized to reduce the impact on the planet. Currently, this type of innovation would be more disadvantageous rather than beneficial. One of the largest technological improvements regarding geothermal energy production is the introduction of the binary cycle. What the binary cycle does is it effectively lowers the boiling point of the water being produced into steam for the plant to operate. The main advantage this holds is that plants can be located in geothermally cooler areas in comparison to the conditions required before the binary cycle was invented. So by further lowering the boiling point of water we can make geothermal power plants more accessible and more efficient.

A few ways we can further the idea of lower the water??? s boiling point is by doing things like adding a surfactant to lower surface tension, lower atmospheric pressure, increase the surface area in contact with the heat source, and pressurize the water so it is somewhat unstable. The first step to utilizing all of these ways to lower water??? s boiling point is to eliminate impractical methods. The only impractical method stated above would be using a vacuum; otherwise all of the other basic concepts have the potential to be implemented effectively. The next step would involve implementing a new pipe design.

This would include a pressurized pipe that would effectively lower the boiling point substantially. This also implies that the water would be heated within the pipe. That means that the magma would heat the pressurized pipe which would allow for more predictability compared to dumping water on pure magma. This could also effectively increase the lifespan of geothermal power plants. This would make them a more appealing investment for power companies because it has the potential to substantially decrease the risk of too much water being poured down in one day, leading to the magma reserves being depleted.

The pipe should be configured in a way to maximize the surface area of the water in contact with the heat source. This could be done by using a thin rectangular pipe with a 10: 1 width to height ratio this keeps the idea realistic and simple enough to implement while still being highly effective. Another technology that could be used to lower the amount of energy required to boil water is the addition of a surfactant. What a surfactant does is ??? loosen??? hydrogen bonds thus making them more easily broken.

That is what boiling water is after all, heating water to an extent that it breaks apart into a gaseous state. Surfactants could aid that process substantially. A common example of a surfactant is household detergent or soap. Ideally we could harness the parts of the detergent required to loosen the hydrogen bonds while leaving out the rest of the unnecessary compounds. This hopefully could be done in such a way that the cost of the surfactant would be compensated for in the increase in efficiency and ability to boil water at a cooler temperature.

By combining all of these ideas we can come up with one new innovative system that could revolutionize geothermal energy production. It starts out with a thin rectangular pipe. This pipe is then pressurized and heated by the magma. Then a surfactant is added to the water before it is placed in the heating chambers. By doing all of this we would be making geothermal energy more available throughout the world, by allowing plants to operate in geothermally cooler areas, and increasing efficiency. The issue of drilling into the earth is another problem associated with geothermal drilling.

When engineers dig into the earth for a viable energy source, unprecedented amounts of pressure and heat are experienced. Therefore, a drill bit resistant to the extreme conditions is necessary for the endeavor. Most geothermal energy plants utilize heat close to the surface of the Earth. However, in order to entirely benefit from geothermal energy one must drill deep into the earth to access the high and consummate temperatures. A conventional rotary drill bit does a sufficient job at drilling into the earth but at depths of three kilometers they are vulnerable to extreme temperature and pressure conditions; rotary drill bits will start to wear out or potentially break. In order to take the drill bit out, engineers must follow a meticulous and expensive process.

The whole process of drilling into the Earth can be extremely uneconomical and inefficient; conventional drilling can cost approximately 60 million dollars to drill a 10 kilometer borehole. Lately, scientist and engineers have been researching new methods more economic and efficient than the previous conventional technique. Recently scientists have come up with a new drilling technique called hydrothermal spallation. The method involves chemically breaking down the rocks rather than physically breaking it down. By catalyzing combustion reaction with oxygen, methanol, and water a flame up to 2000 degrees Celsius is produced. The flame produced can effectively break through layers three kilometers beneath the surface of the Earth.

When the flame hits, the rock will begin to crack producing spalls (thin flakes). The spalls will then flake of the surface of the rock. Hydrothermal spallation is seemingly a more feasible option than conventional drilling; it is more advantageous than drilling because it does not rotate the drill string and it does not make physical contact with the rock. The absence of physical contact prevents abrasion of the bit; therefore, the method more economic and efficient than drilling.

However, hydrothermal spallation is problematic. When drilling with this method, it is difficult to prevent overheating of the rock. Overheating will cause the rock to melt rather than ??? flake off???. Furthermore, when the rock layer is exposed to extreme temperature differences, it begins to experience linear expansion. The expansion then cracks the rock. As result problems with seismic activity are created.

An improvement that can be made to this process is controlling the heat and amount of the flame so that the process can be monitored. If this process is perfected, geothermal energy will become much more accessible. Geothermal heat pumps are extremely efficient. It uses the heap pump system (an application which moves heat from place to place) to use heat from the earth to provide heating, air conditioning, hot water, and energy. About 10 feet below the earth??? s surface, there is constant temperature.

With this benefit, GHPs that contain water or antifreeze solution are installed down there. The heat acquired from the pipes is transferred to a generator to produce heat and energy. There are two main types of GHPs, closed loop systems and open loop systems. Closed loop systems run vertically or horizontally, depending on the space available. Open loop systems use wells or surface body water as the heat exchange fluid to circulate through the GHP system. However, there are several disadvantages to GHPs.

These cons include the requirement of electricity to operate and drive the pump. Also, because heating performance depends on weather conditions, it can be least effective when ground temperature is low. Some safety disadvantages are in open loop systems. They require supply of fresh water and this used water must be disposed of properly.

Although it isn??? t toxic, it can cause problems because of its large volume. The antifreeze solutions are also harmful to the environment if they leak from the pipe due to breaking. The biggest issue of GHPs is the cost of installment. It is very difficult and expensive to build the plants and drill to make it. Using GHPs to produce energy instead of only heating homes can be an excellent way to use geothermal energy.

Pipes and pumps can save space rather than having huge power plants and this will be more widely available in states like NJ. Also, another great way to use GHPs for energy is to make the pipes longer and set it to the deepest possible depth it can beneath the earth. By doing this, the pipes can store more steam and hot water without having electrically generated heaters. The heat and the pressure gained from the pipes can help to spin a turbine or generate an engine by moving the piston to produce power.

In order to enhance the pipes, they can be enlarged to produce more heat at once. To do this, extremely conducting antifreeze solutions can be used for the pipes. With technological advancements in chemistry will make this possible. Also, for durability and stability, the pipes can be made with more sturdiness and it can be thickened to prevent breaks or damages. An additional improvement to the current technology can be reducing the space needed for the plants. In order to do this, geothermal energy generators can be located in only one location in a town for the entire town to use.

With just one place with a huge generator, space will be saved and drilling costs will be reduced. These plants will be owned by the individual town opposed to the government. This will be a huge money-saver and improvement on using geothermal energy as a main source of power for this nation. Bibliographyhttp://www. physicsclassroom. com/class/thermalP/u18l1f. cfmhttp://www. ready. gov/nuclear-blasthttp://www. nuclearfiles. org/menu/key-issues/nuclear-weapons/issues/effects/effects-of-nuclear-weapons. htm