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THE SECRETARY,
HOUSE OF REPRESENTATIVES,
STANDING COMMITTEE ON SCIENCE AND INNOVATION,
PARLIAMENT HOUSE, CANBERRA, ACT. 2600.

Dear Sir/Madam,

We refer to your request for submissions in the area "The Science and Application of Geosequestration Technology".
Adopting the headings you have used we submit as follows:-

1. **The Science underpinning geosequestration technology** (and alternatives).

It seems apparent to us that the science suggests that you do not attempt geosequestration of carbon dioxide (CO2), which we assume to be your main purpose and we suppose that other gases, such as various nitrous oxides (NOx) and oxides of sulphur (SOx) will also find their way to the selected burial site.

It is fighting against the laws of physics and chemistry to try and entomb the above mentioned gases (the gases) underground at what may be thought of as "safe depths", such depths meant to prevent their escape to atmosphere.

From physics, the greater the depth in the earth, the greater the temperature and therefore the higher the pressure which has to be utilised to fill the geological strata with the gases.
This entails a higher use of energy, which in turn produces further gases.

From chemistry we know that if, as is most likely, liquids are present with the gases the formation of acids will follow. Those acids will eat away the rock (as in caves in limestone) and as we have a mixture of acids, the weakening of the rocks by this action could be rapid, leading to escape pathways for the gases.

A recent experiment in USA has recorded the following result:-

“Carbon dioxide's great underground escape in doubt

18 July 2006
From New Scientist Print Edition.

LOCKING carbon dioxide underground sounds like a neat way of getting rid of it - but not if it eventually leaks out again.

In October 2004 experimental CO_2 injection began at the Frio formation, an old brine-filled oil reservoir on the Texas Gulf Coast. Yousif Kharaka from the US Geological Survey in Menlo Park, California, and colleagues collected fluid and gas samples before injection began, and at regular intervals afterwards. More recent samples suggest that minerals in the rock walls, including carbonate, are being dissolved by the mixture of CO_2 and saltwater in the reservoir.

If enough carbonate is dissolved this could create tunnels in the rock through which the CO_2 gas may seep out into the atmosphere again (*Geology*, vol 34, p 577).

While this hasn't happened yet at Frio, Kharaka says that it could be a problem at other sites, particularly where existing cracks in the rocks are filled with carbonate-rich minerals. If organic compounds and trace metals dissolved in the brine also leak out, they could contaminate groundwater, Kharaka says.”

It is possible that carefully selected sites could avoid moisture problems for the great part, but it is doubtful that moisture could be entirely excluded and it would not seem practical.

An experiment, similar to the above is being conducted in south west Victoria.

OCEAN SEQUESTRATION – AN ALTERNATIVE, AMONG OTHERS
A timely release from the National Academy of Sciences in USA is:-

“Permanent carbon dioxide storage in deep-sea sediments (climate change | CO2 hydrates | energy | sequestration)
Kurt Zenz House *, Daniel P. Schrag *, Charles F. Harvey , and Klaus S. Lackner
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Communicated by John P. Holdren, Harvard University, Cambridge, MA, June 27, 2006 (received for review November 10, 2005)

Stabilizing the concentration of atmospheric CO2 may require storing enormous quantities of captured anthropogenic CO2 in near-permanent geologic reservoirs. Because of the subsurface temperature profile of terrestrial storage sites, CO2 stored in these reservoirs is buoyant. As a result, a portion of the injected CO2 can escape if the reservoir is not appropriately sealed. We show that injecting CO2 into deep-sea sediments <3,000-m water depth and a few hundred meters of sediment provides permanent geologic storage even with large geomechanical perturbations. At the high pressures and low temperatures common in deep-sea sediments, CO_2 resides in its liquid phase and can be denser than the overlying pore fluid, causing the injected CO_2 to be gravitationally stable. Additionally, CO_2 hydrate formation will impede the flow of CO_2(l) and serve as a second cap on the system. The evolution of the CO_2 plume is described qualitatively from the injection to the formation of CO_2 hydrates and finally to the dilution of the CO_2(aq) solution by diffusion. If calcareous sediments are chosen, then the dissolution of carbonate host rock by the CO_2(aq) solution will slightly increase porosity, which may cause large increases in permeability. Karst formation, however, is unlikely because total dissolution is limited to only a few percent of the rock volume. The total CO_2 storage capacity within the 200-mile economic zone of the U.S. coastline is enormous, capable of storing thousands of years of current U.S. CO_2 emissions. "

From the above it can readily be seen that geosequestration is working **against** the laws of nature and that ocean sequestration is working **with** the laws of nature. By injection of liquid CO_2 into the ocean sediments at greater than 1,000 metres depth any increase in the acidity of the ocean is most unlikely.
By contrast, the acidification of the ocean surface layers is a matter of current and substantial concern.

CSIRO has examined the various suggested methods of CO_2 sequestration and found itself cautiously in favour of ocean sequestration. See, "Australian Hydrogen Activity" pages 21-3, published May 2005.

OTHER ALTERNATIVES – MINERALISATION
The process of forming carbonates or other minerals, depending on the gases, has been looked at and the cost means that there is little support for it.

INCREASE BIOMASS – REVERSE LOSS OF OXYGEN
An important consideration in sequestration of unwanted gases is to examine what we are losing. In this case it is a lot of oxygen in the gases. This is being shown in declining levels of oxygen in the atmosphere. Oxygen is the fuel for engines, including the human engine. Already, oxygen is being offered for sale on the streets of major cities. How far do we go?

CO_2 is not a waste gas for plants. Plants are an essential part of our food chain. Current problem is that we have an excess of CO_2 in our atmosphere.
The fact that oxygen levels are declining indicates that we have insufficient biomass to convert the available levels of CO_2.

It is possible to massively increase the biomass levels by planting the deserts with salt tolerant plants (halophytes). These plants are currently developed by Professor Nick Yensen of Tucson and involve our Company. They will thrive in salinity one third of seawater up to seawater, depending on the plant.
Forage is well developed and becoming available commercially, as is turf.
"Wheat" needs further development, but can grow in seawater.
These halophytes love heat and bright sunlight, as exists in the majority of deserts.
Needed is sufficient brackish water to provide the correct salinity level for the plant. They assist in oil remediation, such as in oil slick areas.

The plants are economically viable at this time in most situations, but will repay further R&D to increase the economics by higher yields, greater palatability, etc.

Very clearly, these plants have much to offer Australia with its vast saline areas, also to the rest of the world where food can be supplied by these plants and the animals which like to graze upon them, eating the halophytes as a preference to fresh water plants (glycophytes). The halophytes constitute a built in salt lick.

A further benefit would be reverse climate change by reducing the aridity of the desert areas. Wind power can be used to pump the salt water inland.

2. The potential environmental and economic benefits and risks of such technology.

Risks

- That there are insufficient geological reservoirs to accept the CO2 to be sequestrated and, for the most part, they are inconveniently placed.
- The risk of a CO2 "bomb" is obliquely mentioned above.
- Increased risk of groundwater poisoning.
- Geosequestration areas, including assets therein, become quarantined.

Economic risks

- The enormous risk is to the competitive cost structure of Australian industry. Cost of geosequestration in Gippsland is put at $52 per tonne by the CO2CRC and $8.00 per tonne under the most favourable conditions on the NW shelf.
- Compared to the above risk, the cost of imposts on our exports by some nations may be much lower.
- Economic deposits of mineral in saline aquifers may well be lost, including magnesium, calcium, boron, etc.

- Water supplies gained from treating the water in saline aquifers could be lost at a time when purification technology is making potable water and recovery of the minerals possible. See, www.cdtwater.com.

Environmental benefits

- The reduction of CO_2 from the sequestration of CO_2 from all of our power stations is an environmental benefit in many ways, not the least of is a cleaner atmosphere. Add to that reduction of NO_x and SO_x which is possible.
- Thermoacoustic cooling of power station exhaust gases removes the need to use water and reduces salinity build up which occurs by concentrating salt in that water. E.g. use of sewage water proposed for Latrobe Valley cooling towers, then released into Gippsland rivers and lakes.
- Geosequestration in the ocean beds will permanently remove any atmospheric threat from the CO_2.
- Geosequestration in the ocean silts will virtually eliminate acidification of sea water, certainly to a point markedly lower than the current situation which is killing coral and dissolving the shells of marine life.

Economic benefits

- Thermoacoustic liquefaction of CO_2 and possibly other gases, can be done for as little as $3.00 per tonne, followed by placement in the ocean silts at $6-10 per tonne, depending on circumstances. This is markedly cheaper than terrestial geosequestration in old gas reservoirs, etc.
- Exports of coal will be enhanced.
- Exports of the thermoacoustic know how will create another industry of importance.
- Greenhouse credits earned, if applicable, would be large.
- Industry retained in Australia.
- Australian security enhanced by use of our coal.

The skill base in Australia to advance the science of geosequestration technology:- is quite adequate.
Experiments are being conducted on terrestial geosequestration and similar experiments need to be conducted on ocean geosequestration below the sediments, which involves finding out where the desirable sediments lie. Using satellite laser and sonar technology it is not difficult to locate the sediments, then to determine the best method of deposition under them.

It is requested that funding is made available for this work.

Regulatory and approval issues governing geosequestration technology and trials

The largest regulation hurdle for trials on ocean geological sequestration is the belief by some, perhaps at the Department of Environment, that the CO2 is waste and that it is prohibited by the 1992 London protocol on dumping of wastes at sea.

If it is so prohibited then some negotiations would appear to be in order, however others believe it is not prohibited and that would appear to include USA.

How best to position Australian Industry to capture possible market applications.

As above, there are enormous export orders to be won for "clean coal" and the technology to produce electricity without CO2 emissions to atmosphere.

It should be remembered that the technology of thermoacoustic cooling applies equally to gas fired power stations and to many industrial situations.
There will be spin off industries which use the acoustic technology, which industries are different to the central situation here.

If, in Australia, we are able to economically produce power without greenhouse emissions then the position of Australian industry is entrenched. Otherwise, a substantial loss of industry appears most likely.
It is possible that "green credits" could apply to Australian exports.

Respectfully submitted,

John Martin

John Martin
Director