Ocean pH (so-called acidification)

What is pH?

It is a scale running from 0 to 14, and is a measure of an aqueous solution's acidity or alkalinity.

A pH of 7 is neutral and values above that indicate alkalinity and below that indicate acidity.

What is acidification?

Water exposed to air slowly becomes mildly acidic because atmospheric carbon dioxide (CO_2) dissolves in the water. When dissolved in water, CO_2 reacts with water to give carbonic acid, H_2CO_3, as shown by the equation:

$$H_2O + CO_2 \rightleftharpoons H_2CO_3$$

Ocean pH (so-called acidification)

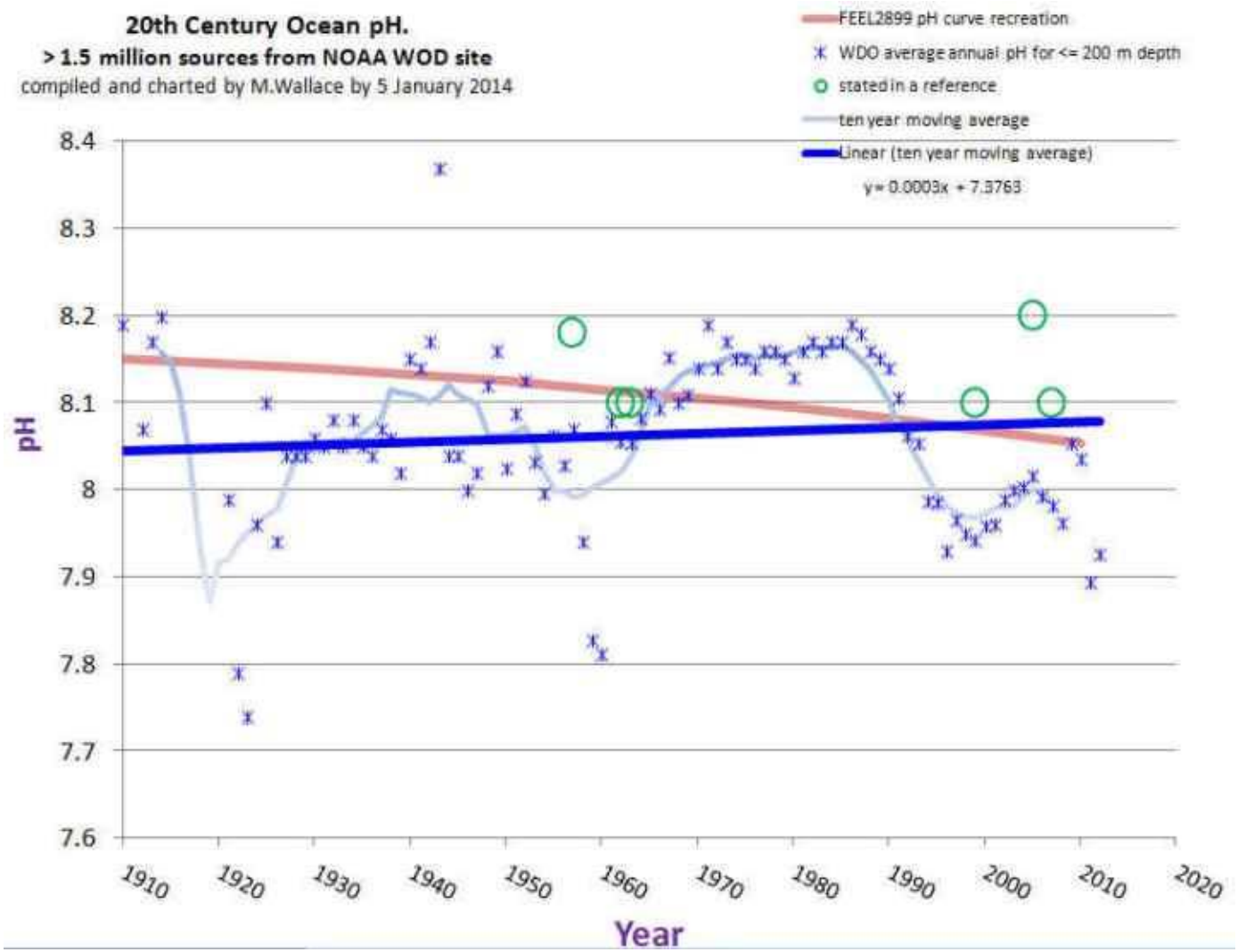
An empirical re-evaluation of the boron isotope/pH proxy in marine carbonates
by Klochko, Kateryna, Ph.D., University of Maryland, College Park, 2009, 156; 3372972
Abstract (Summary)

The boron isotopic composition measured in marine carbonates is considered to be a tracer of seawater pH. However, an accurate application of this proxy has been hampered by our lack of intimate understanding of chemical kinetics and thermodynamic isotope exchange between the two dominant boron-bearing species in seawater: boric acid B(OH)3o and borate ions B(OH)4-, as well as their subsequent partitioning into a carbonate lattice. In this dissertation I have taken on a task of a systematic empirical re-evaluation of the fundamental parameters and assumptions on which the boron isotope paleo-pH proxy is based. As a result of this research strikingly different values of the boron isotope exchange constant in solution (Klochko et al., 2006) and boron speciation and partitioning in carbonates (Klochko et al., 2009) were determined, **suggesting that the most parameters and assumptions that were believed to be previously constrained and have been widely applied to the δ11B-pH reconstructions were incorrect.**

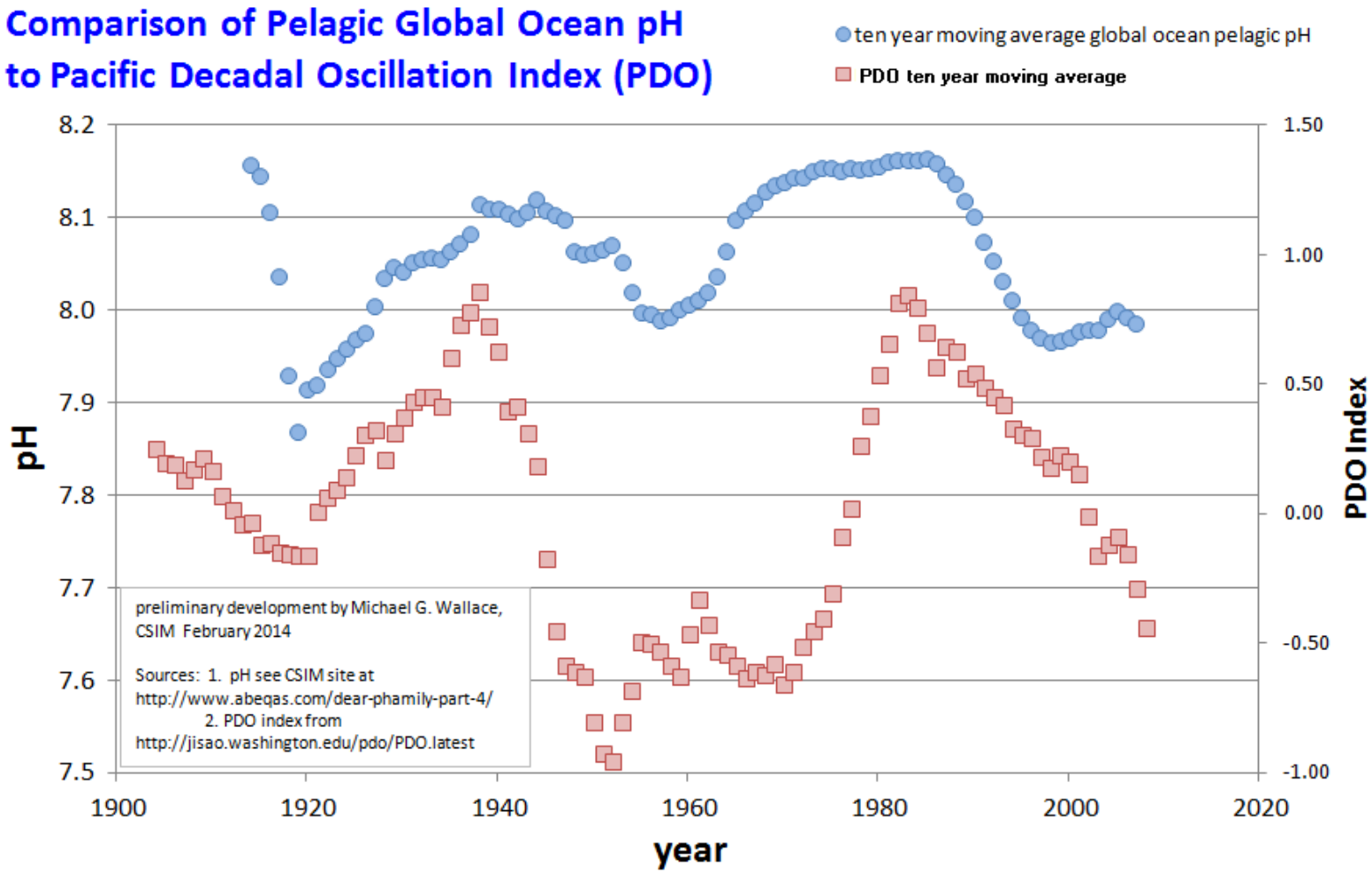
Recognizing that both biological and inorganic processes may potentially affect boron speciation and isotopic composition in carbonates, to isolate purely inorganic effects on the boron isotope co-precipitation with carbonates, we have designed a series of pH-controlled δ11B calibration experiments of inorganic calcite and inorganic aragonite. Results to date reveal that precipitates from our experiments at pH = 8.7 fall exactly along the borate ion δ11B curve predicted by our empirically determined boron isotope fractionation factor (Byrne et al., 2005; Klochko et al., 2006).

Extending these experiments to wider range of pH conditions will provide the necessary inorganic baseline for paleo-studies of inorganic carbonate and future investigations of the purely biological effects on the boron isotope distributions in carbonates.

Ocean pH (so-called acidification)



Ocean pH (so-called acidification)



https://www.abeqas.com/

The Ozone Hole

What is ozone?

Ozone is a form of oxygen

'Ordinary' oxygen, part of what we breath in with every breath (~21%), is two atoms of oxygen combined – chemically written as O_2

Ozone is formed by three atoms of oxygen combining – chemically written as O_3

Ozone is inherently unstable and very reactive

It is strong absorber of ultra violet radiation of a particular wavelength, and is assumed to protect us and other life forms from its damaging effects.

The Ozone Hole

A bit of history

Ozone was first recognised as a substance in 1840, and the idea that it existed in the atmosphere was suggested by British chemist W. N. Hartley in 1880.

In the mid 1920s, Gordon Dobson, a British physicist and meteorologist, invented a new type of spectrometer to measure its concentration in the atmosphere. He discovered that not only was there a day-to-day fluctuations in its concentration, but also regular seasonal variations. He established the unit of measurement for ozone, the Dobson Unit - still in use today.

The Ozone Hole

A bit of history cont…

In the 1950s (linked to the International Geophysical Year of 1957), measurements of ozone were made in Antarctica

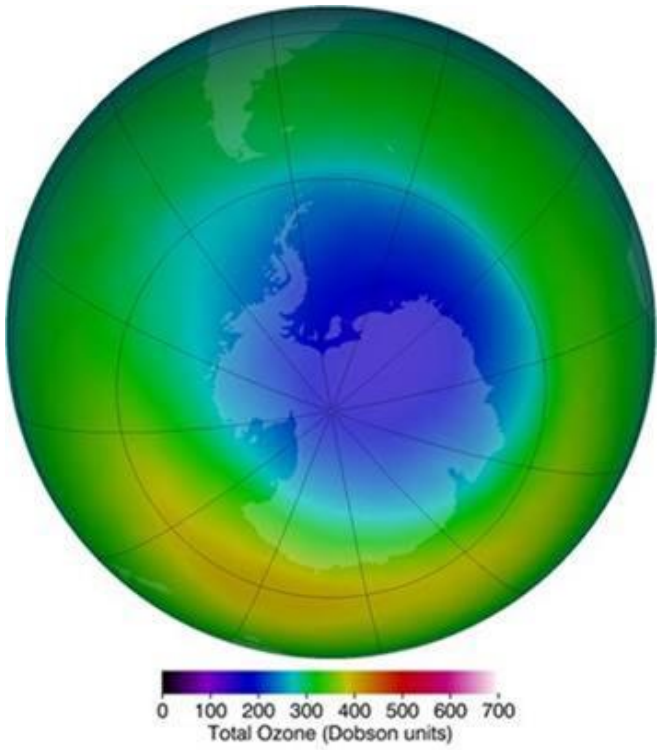
These were the measurements that first discovered that the Antarctic ozone faded away from August to November (now referred to as 'The Hole' and in fact containing 200 DU or less) – Note: CFCs, cited as the main culprit for this, didn't come into large scale use until the sixties!

In 1974 Molina and Rowland developed what became known as the fluorocarbon-ozone theory.

This is the main evidence put forward to justify the ban on CFCs

The Ozone Hole

The Scare



Although there was no evidence of any significant global shift in ozone, Satellites had enabled a much better view of the Antarctic situation.

This ultimately led to the banning or sever restriction of CFCs (chlorofluoro hydrocarbons) and many other halogenated substances.

What got neatly ignored were halogens, particularly chlorine, from natural sources.

The Ozone Hole

Other observations

Mount Erebus

When accurate measurements of the volcanic gases were taken in 1983, the hydrogen chloride and hydrogen fluoride emissions of Mt. Erebus were 1,230 tons per day and 480 tons per day, respectively.

Satellites were detecting the development of the ozone hole a full month before the appearance of sunlight. In Molina's chemistry, sunlight is the "trigger" for the chemical reaction that destroys ozone molecules.

IPCC Reports and Species Extinction

In 2014 the UN published *IPCC Synthesis Report*, which gathered the most important information of its last three climate reports. It came to almost 120 pages; about as long as the summaries of the three previously published climate reports together, all titled *"Summaries for Policymakers"*.

Previous climate reports by and large showed the current state of science with all its contradictions, this synthesis report omitted significant scientific findings. This distortion is particularly evident in the statements about the predicted extinction of species.

In two places, the extinction of species was discussed (pages 10 and 13). The notion there is exclusively of high risks, the considerable uncertainty of the forecasts and serious gaps in knowledge on the subject were not mentioned.

IPCC Reports and Species Extinction

The Synthesis Report said this about the prediction:

A global warming of four degrees or more since the beginning of industrialization (one degree has already been reached) implies a high to very high risk of significant biodiversity loss which would increase the rate of species extinction. The forecast modelling was given "high confidence."

Experts in the respective chapter of the IPCC 5th Assessment Report state:

Climate models cannot represent various key processes of the evolution of species, which significantly affect the vulnerability of species to climate change. For example: The ability of adaptation of genetic and external features to new environmental conditions, the ability to spread to new habitats, the dynamics of populations, the effects of fragmentation of habitats, the interaction of communities, micro-refuges, the effect of rising CO_2 concentrations on vegetation (pages 299/300).

IPCC Reports and Species Extinction

The Synthesis Report relied on evidence from the past:

The current and predicted rate of climate change is much faster than natural climate change events during the past million years, which have already triggered significant species extinctions. Therefore, there is a strong basis for the assumption that climate change is a risk to living organisms (pages 14 and 25).

However, the thematic chapter of the IPCC 5th Assessment Report states:

Paleontological data from the past hundreds of thousands of years show very low extinction rates during major climatic fluctuations. This evidence may indicate that the predictions of very high extinction rates may be exaggerated. At the end of the Ice Age, there were climate changes of ten degrees Celsius within 50 year in major parts of the world, which is 20 times faster than in the 20th century – greater climate-induced extinctions are not documented. Perhaps because the climate variability mainly affected higher latitudes (pages 432ff).

IPCC Reports and Species Extinction

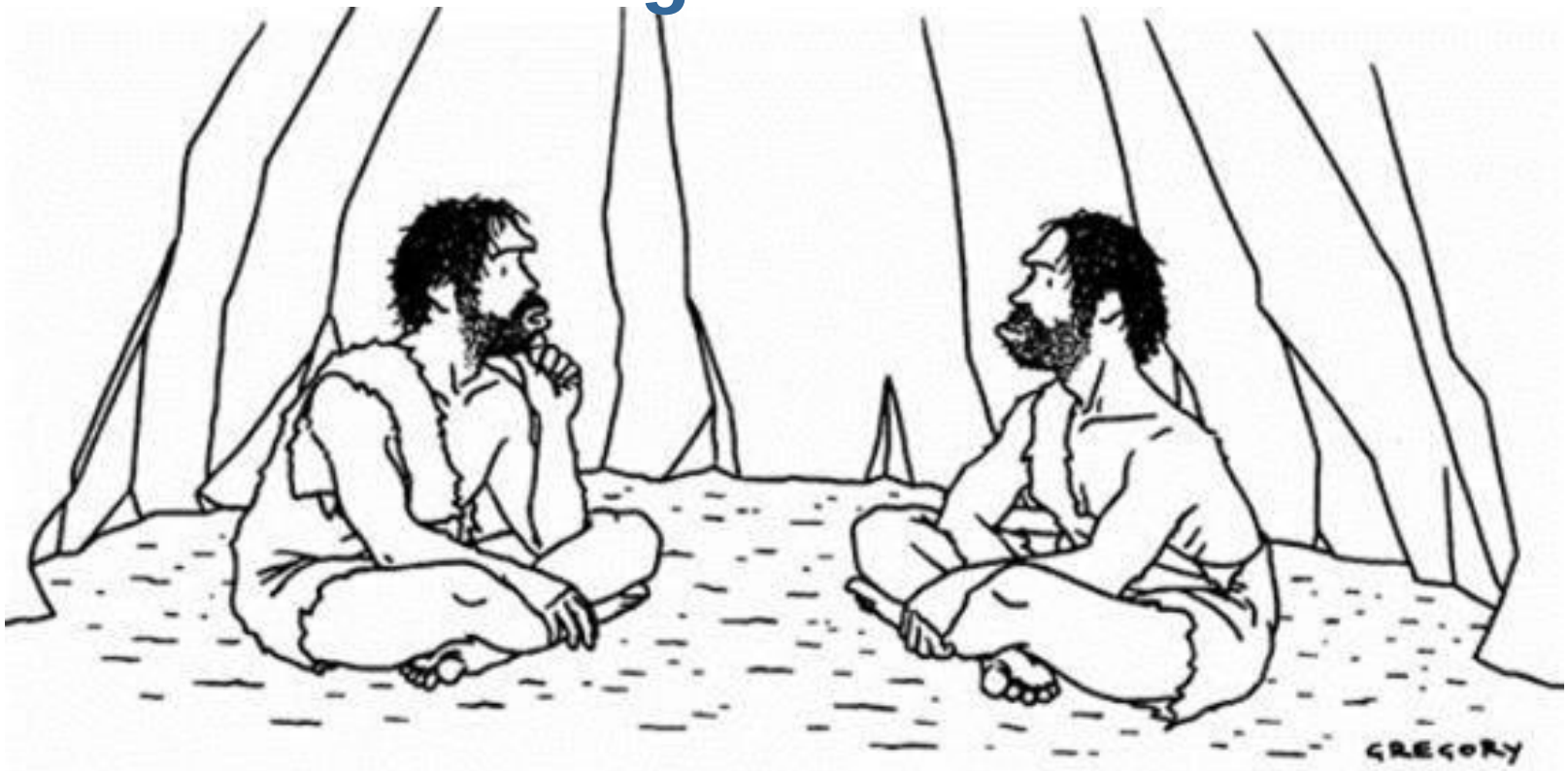
The Synthesis Report said this regarding specific scenarios:

The expected extinction is caused by various climate phenomena such as warming, shrinking rivers, ocean acidification and oxygen depletion in waters. The cause of extinction is both the speed and the strength of global warming (page 26)
Some species with limited adaptive capacity, particularly in the Arctic and in coral reefs, are already threatened with a warming of two degrees compared to the current climate (page 29).

In technical chapter of the 5th Assessment Report, it says:

Studies since the last IPCC Report (2007) have challenged the ability of climate models to predict the future risk of species extinction. The results of the models vary widely and are difficult to check. The uncertainties could be larger than shown in models because essential factors are not taken into account (pages 295, 299, 300).
While the 2007 IPCC Report still predicted that a global warming of two to three degrees threatened to cause the extinction of 20 to 30 per cent of animal and plant species, the new climate report no longer makes any concrete predictions – the uncertainties are too large (pages 299/300). *This does not mean there is no risk; it simply indicates a significant lack of knowledge.*

Where we are heading?



"Something's just not right—our air is clean, our water is pure, we all get plenty of exercise, everything we eat is organic and free-range, and yet nobody lives past thirty."