**CLIMATE CHANGE TEACH-IN**

**October 4-10, 2021**

**Monmouth University**

**Climate Change Panel**

**4:30-6:00 PM, October 6, 2021**

**Moderator: Azzam Elayan**

**A B S T R A C T S**

**What Caused the Younger-Dryas Abrupt Warming Event 11,000 years ago?**

**Matthew Pacicco**

**Abstract**

Anthropogenic climate change has the potential to trigger natural climate feedbacks. Understanding potential positive and negative feedbacks to anthropogenic climate forcings are critical to projecting and adapting to future climate conditions. One such theorized feedback is the Methane Clathrate “Gun” Hypothesis. Methane Clathrates are methane molecules that, due to the low temperature and extreme pressure at the bottom of the oceans, exist in a solid state. When warmed, methane gas (a potent greenhouse gas) is released from these clathrates. The “Gun” hypothesis states that anthropogenic warming of the ocean could cause clathrates to release methane into the atmosphere, leading to further global warming and creating a potentially catastrophic positive feedback loop. To study this hypothesis, scientists investigated the Younger-Dryas/Preboral Abrupt Warming Event (ABE) from approximately 11,000 years ago, where the Earth’s average temperature increased by about 10 oC in 20 years. Methane levels increase significantly as well during this period, leading scientists to hypothesize that perhaps a destabilization of the methane clathrate reservoir was to blame. By evaluating Carbon14/Carbon-12 isotope ratios in Greenland and Antarctic ice cores, researchers were able to effectively determine that methane clathrates were not the source of the excess methane associated with the Younger-Dryas/Preboral ABE. Ice core samples from the period suggest that expansive wetlands, likely formed in the wake of retreating continental ice sheets, were the main source of methane and the cause of the ABE. This discussion will use the Clathrate Gun hypothesis to highlight the rigors of the scientific process, using an example of a climate change hypothesis that was disproven to show how scientists approach these questions and attempt to understand how humanity is currently changing the climate.

**How Geology Uses C and O Isotopes to Make Paleoclimate Determinations and Decipher Role of Human Activity in Climate Change**

**Michael Tarullo**

**Abstract**

Graphs of past temperature changes and carbon dioxide levels (CO2) reveal that the present day level of atmospheric CO2, which is currently about 400 parts per million (ppm), is much higher than it has been in at least the recent geologic past and possibly higher than in Earth’s 4.5 billion year history. But how do we know what climatic conditions were like in the geologic past? Certainly, in the ancient geologic past man was not present to keep such records and only more recently has the instrumentation become available to record and maintain accurate climate and atmospheric conditions. Through the hard work and ingenuity of many scientists, particularly Earth scientists, a number of proxy methods have been developed that yield accurate paleoclimate data. One of these proxies is the measurement of 18O – 16O and 13C – 12C isotope ratios in the shells (tests) of microfossil planktonic and benthic organisms. Isotopes are atoms that have additional neutrons in their nucleus. Isotopes can be stable or unstable. Oxygen (O2) and carbon (CO2, HCO3-1, CO3-2; collectively known as dissolved inorganic carbon (DIC)) are important constituents of seawater chemistry. These molecules, dissolved in seawater, contain varying amounts of stable oxygen and carbon isotopes. Some planktonic and benthic marine organisms construct their calcium carbonate (CaCO3) tests from the oxygen and carbon dissolved in seawater. The isotopes of oxygen (18O and 16O) and carbon (13C and 12C) used in microfossil paleoclimate studies are, therefore, also stable. Also, the oxygen and carbon isotopic composition of the ocean varies with time, depth temperature and other conditions. As such, microfossil tests then become a record of the oceanic and atmospheric conditions at the time their tests were created. When these organisms die they accumulate in ocean floor sediment. Since the isotopes of oxygen and carbon used in the construction of their tests are stable, the tests become a permanent record of past climate conditions. To unlock the paleoclimate data, cores of seafloor sediment are taken. Microfossil tests are extracted from the sediment cores, prepared and analyzed using mass spectroscopy for their oxygen and carbon isotopic ratios.

**The Spatial Planning for Area Conservation in Response to Climate Change**

**Caitlin Kelley**

**Abstract:**

The Spatial Planning for Area Conservation in Response to Climate Change ([SPARC](https://linkprotect.cudasvc.com/url?a=http%3a%2f%2fwww.sparc-website.org%2f&c=E,1,bvY3QuJzLHFt6WmX_j6S0a7nUPnu5obmftuc0XIPVWgJq_g4dZuQwFi6fT5WndGwT4-ppNEkje1n_hN7uMOtmhhHPxTQfAk3pMzw-PwgBBAAFS5cAcET1NQQ--w,&typo=1)) project modeled the future distributions of 289,219 species under contrasting climate futures to study how land conservation and climate action can work together to reduce extinction risk. Based on these projections, we identified the highest priority land areas for strengthening the climate resilience of existing protected area networks. Our findings indicate that limiting climate change to 2 °C and conserving 30% of terrestrial land could reduce extinction risk across the tropics by more than 50%. Using South Africa as a case study, we will illustrate how countries are integrating these data insights into local, regional, and national policies to strengthen the integrity and representation of their conservation networks in preparation for future conditions.