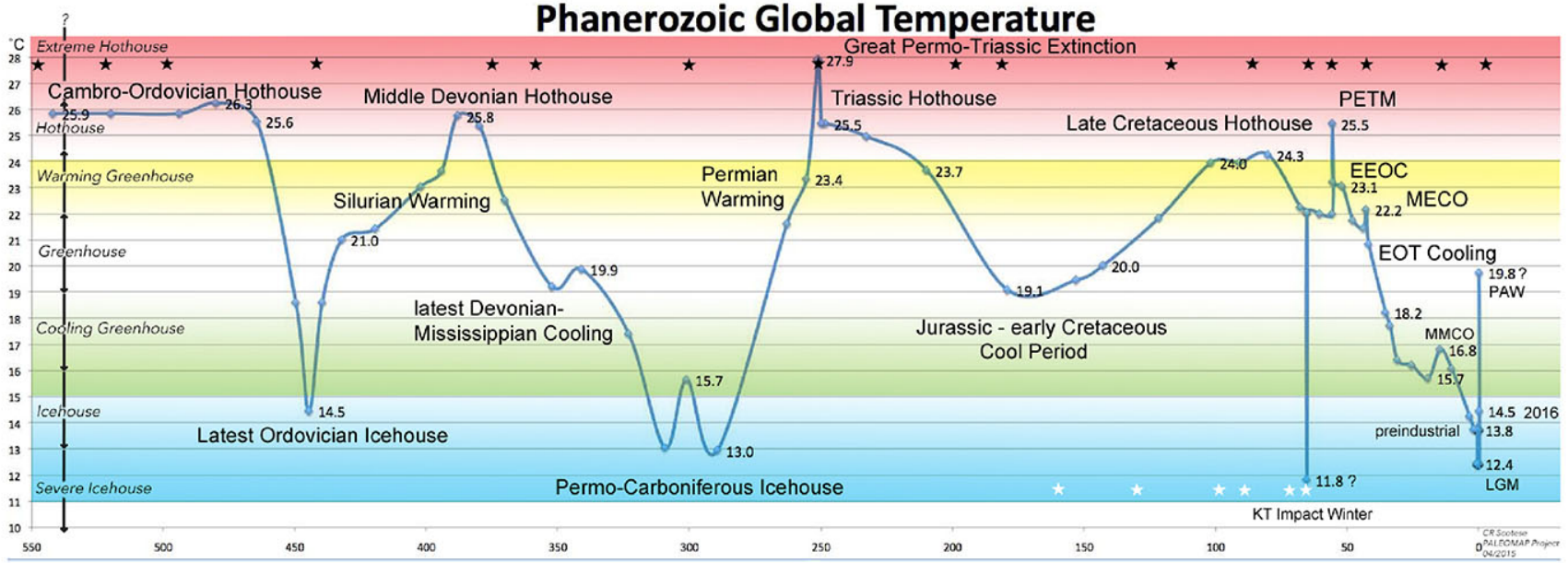

Figure 1. PETM = Paleocene-Eocene Thermal Maximum (55.8 Ma), EEOC = Early Eocene Climatic Optimum (54 -46 Ma), MECO=Mid-Eocene Climatic Optimum (42 Ma), EOT= Eocene-Oligocene Transition (40-33 Ma), MMCO=Mid-Miocene Climatic Optimum (15-13 Ma), LGM= Last Glacial MAximum (21,000 years ago), PAW = Post-Anthropogenic Warming (+5000 - 10,000 years in future). White stars indicate speculative rapid cooling episodes (Stoll-Schrag Events at 160,127,97,91, 71 & 65 Ma). Black stars represent speculative, rapid warming episodes (Kidder-Worsley Events) at 542, 520, 499, 444, 374, 359, 300, 251, 200, 120, 93, 66, 56, 43, 15 Ma, and Present-day.

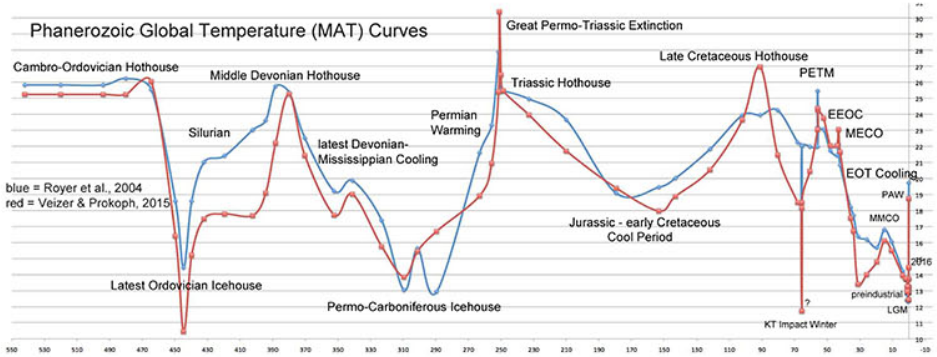

Figure 2. Global Temperature Curves based on Two Different Estimates of Tropical Sea-surface Temperatures.

How Confident are we that all of this is Correct?

How well do we really know all of this? Well, the geological interpretation is "rock solid" - really. After more than 200 years of looking at, describing, and mapping rocks, geologists really have a handle on the stratigraphic record. However, I'm not an expert in oxygen isotopes, so I thought I'd redo the global climate model using a recently published, independent oxygen isotope dataset (Figure 2, Veizer and Prokoph, 2015). As you can see, the curves - at least to a geologist's eye - have basically the same shape; however, there are some important differences. Figure 3 highlights the similarities (capital letters) and some of the important differences (numbers).

Interestingly, the Veizer-Prokoph curve indicates that there may have been relatively short-lived cooling events in the 1. late Silurian-early Devonian, 2. middle Permian, 3. a prolonged early Cretaceous cool period, a particularly anomolous cool period during the latest Cretaceous - prior to the KT "impact winter", and 4. a more severe temperature decline during the Eocene-Oligocene transition (EOT).

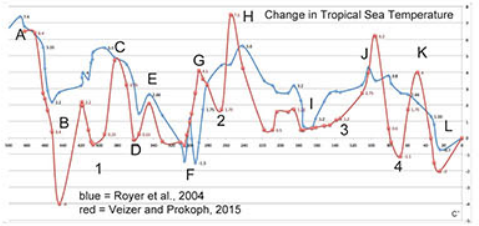

Figure 3. Change in Tropical Sea Surface Temperatures from oxygen isotope data. Capital Letters = Agreement, Numbers = Disagreement

Key References: Scotese (2015), Boucot, Chen Xu, and Scotese (2013), Royer et al. (2004), Veizer and Prokoph (2015), Frakes et al., (1992), Berner and Kothvala(2001), Dromart et al.(2003), Golovneva (2000), Goswami (2001), Gradstein et al.(2012), Hambrey et al. (1990), Huber (1998), Kennett (1995), Kidder and Worlsey (2012), Kotteck et al. (2006) Lecuyer et al. (2003), McInerney and Wing (2011), Miller et al.(2003), O'Hondt and Arthur (1996), Prirrie et al. (1995), Prokoph et al. (2008), Puceat et al. (2007), Sellwood et al. (1994), Stoll and Schrag (1996), Upchurch et al. (2015), Wilson and Norris (2001), Wilson et al. (2002), Wing (1998), Zachos et al. (2001) (for a complete bibliography see handout.)