Ice Sheets and Climate - Eric Keenan - Homework # 1

Due February 10th

In [1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

1. Marine Records

1.b. Benthic d18-O has generally been increasing over the last 70 million years. This means that ice volumne has been increasing. As ice sheets grow, d18-O depleted water accumulates on ice sheets which means that d18-O enriched water accumulates in the ocean.

1.c. 34 million years ago there was a sudden increase in d18-O, this indicates a cooling of the climate. Therefore it is likely that 34 million years ago, ice sheets developed and grew on Earth leading to the observed increase in d18-O.

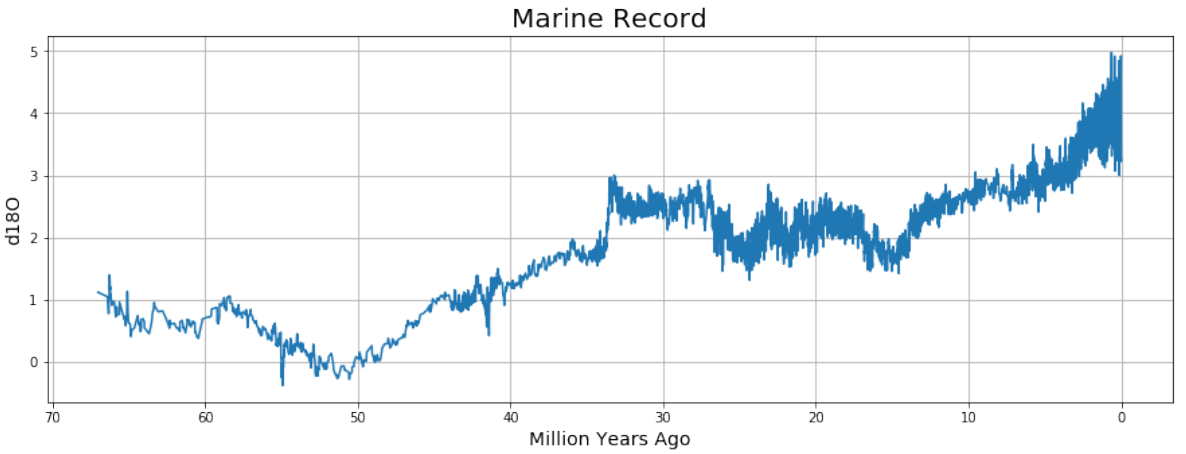
1.d. Milankovich is high frequency, long term carbon cycle?

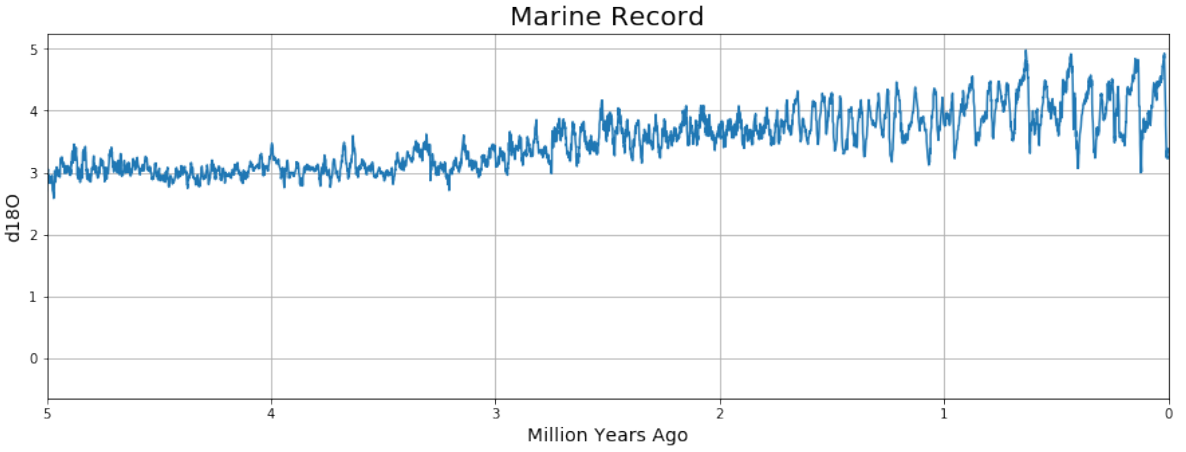
In [2]:

```
# Load data
file_path="zachos2001.csv"
zachos = pd.read_csv(file_path)
marine_time = zachos['Age (Ma)']
marine_d18O = zachos['d18O(5pt**)']

# Plot
fig1 = plt.figure(1, figsize=(15,5))
plt.plot(marine_time, marine_d18O)
plt.xlabel("Million Years Ago", fontsize=14)
plt.ylabel("d18O", fontsize=14)
plt.title("Marine Record", fontsize=20)
plt.gca().invert_xaxis()
plt.grid()

fig1 = plt.figure(2, figsize=(15,5))
plt.plot(marine_time, marine_d18O)
plt.xlabel("Million Years Ago", fontsize=14)
plt.ylabel("d18O", fontsize=14)
plt.title("Marine Record", fontsize=20)
plt.xlim([0, 5])
plt.gca().invert_xaxis()
plt.grid()
```





2. Ice Cores

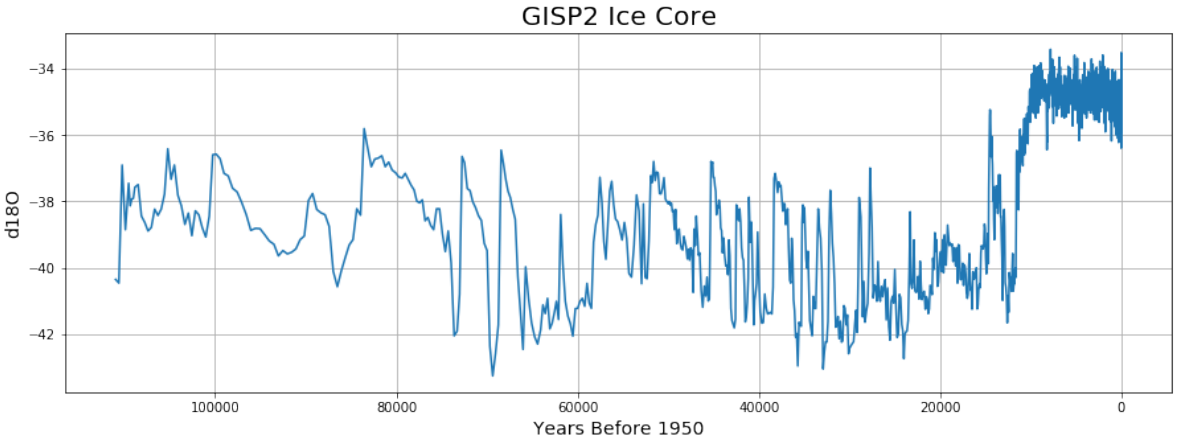
GISP2

In [3]:

```
# Load data
file_path="gispd18o.txt"
gisp = np.loadtxt(file_path, skiprows=51)
gisp2_depth = gisp[:,0]
gisp2_d18O = gisp[:,1]
gisp2_age = gisp[:,2]

# Filter data
gisp2_age[gisp2_age > 200000] = np.nan
gisp2_age[gisp2_d18O > 10] = np.nan
gisp2_d18O[gisp2_age > 200000] = np.nan
gisp2_d18O[gisp2_d18O > 10] = np.nan

# Plot
fig3 = plt.figure(3, figsize=(15,5))
plt.plot(gisp2_age, gisp2_d18O)
plt.xlabel("Years Before 1950", fontsize=14)
plt.ylabel("d18O", fontsize=14)
plt.title("GISP2 Ice Core", fontsize=20)
plt.gca().invert_xaxis()
plt.grid()
```

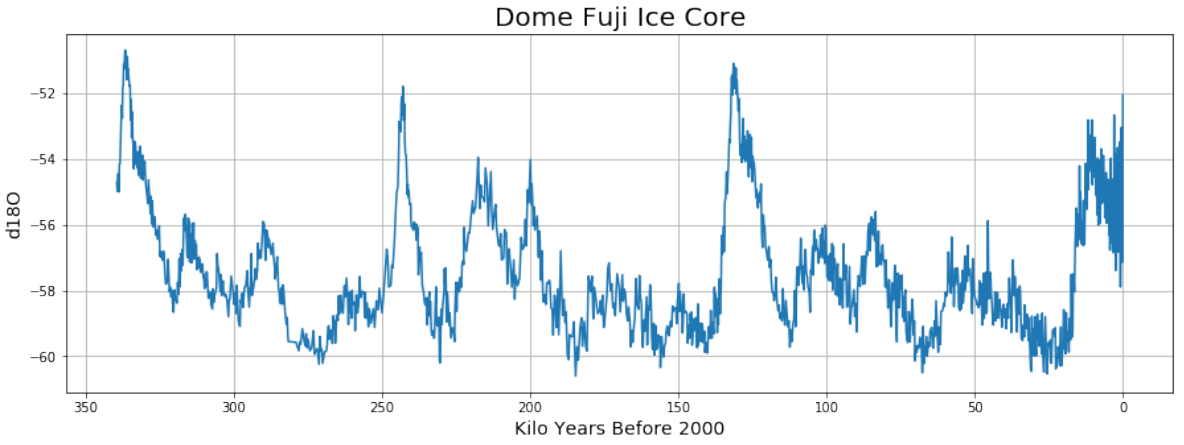


Dome Fuji

In [4]:

```
# Load data
file_path="df2012isotope-temperature.txt"
df = np.loadtxt(file_path, skiprows=1, usecols=(1,2,3,4,5,6,7))
df_age = df[:,3]
df_d18O = df[:,4]

# Plot
fig4 = plt.figure(4, figsize=(15,5))
plt.plot(df_age, df_d18O)
plt.xlabel("Kilo Years Before 2000", fontsize=14)
plt.ylabel("d18O", fontsize=14)
plt.title("Dome Fuji Ice Core", fontsize=20)
plt.gca().invert_xaxis()
plt.grid()
```

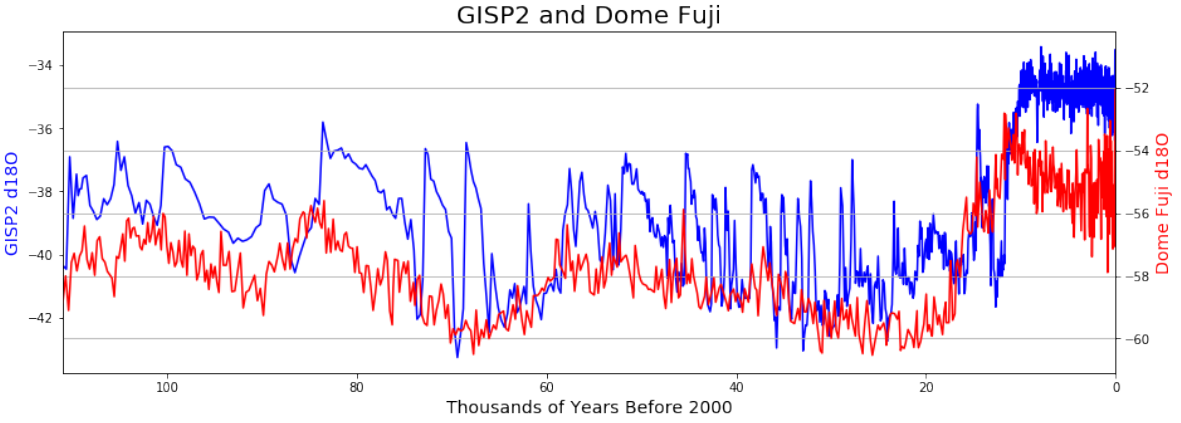


GISP2 and Dome Fuji

In [6]:

```
# Data manipulations, convert to thousands of years before 2000
gisp2_age_yb2000 = (gisp2_age + 50) / 1000
df_age_yb2000 = df_age
gisp2_max = np.nanmax(gisp2_age_yb2000)

# Plot
fig5, ax1 = plt.subplots(figsize=(15,5))
ax2 = ax1.twinx()
ax1.plot(gisp2_age_yb2000, gisp2_d18O, 'b')
ax2.plot(df_age_yb2000, df_d18O, 'r')
ax1.set_xlabel("Thousands of Years Before 2000", fontsize=14)
ax1.set_ylabel("GISP2 d18O", fontsize=14, color='b')
ax2.set_ylabel("Dome Fuji d18O", fontsize=14, color='r')
plt.title("GISP2 and Dome Fuji", fontsize=20)
plt.xlim([0, gisp2_max])
plt.gca().invert_xaxis()
plt.grid()
```



3. Ice Cores and Marine Cores

In [9]:

```
# Data manipulations, convert to thousands of years ago
df_age_yb2000 = df_age
marine_time_yb2000 = marine_time * 1000
df_max = np.nanmax(df_age_yb2000)

# Plot
fig6, ax1 = plt.subplots(figsize=(15,5))
ax2 = ax1.twinx()
ax1.plot(marine_time_yb2000, marine_d18O, 'b')
ax2.plot(df_age_yb2000, df_d18O, 'r')
ax1.set_xlabel("Thousands of Years Ago", fontsize=14)
ax1.set_ylabel("Marine d18O", fontsize=14, color='b')
ax2.set_ylabel("Dome Fuji d18O", fontsize=14, color='r')
plt.title("Marine Core and Dome Fuji Ice Core", fontsize=20)
plt.xlim([0, gisp2_max])
plt.gca().invert_xaxis()
plt.grid()
```