SCIENCE FOCUS: Seawater Chemistry (and Ancient History)

The Sea of Marmara: Where Ancient Myth and Modern Science Mix

MODIS image excerpt showing the Sea of Marmara, acquired on June 25, 2003, with a bloom of coccolithophorids covering the entire sea basin.

On the next page is a larger image excerpt showing the entire region.

MODIS image of the Sea of Marmara, acquired on June 25, 2003, showing a bloom of coccolithophorids covering the entire sea basin. The Black Sea is at upper right, and the Aegean Sea is at lower left. Part of Greece is visible at the lower far right of the image. The surface of the Black Sea appears bright due to sun glint. Country borders are shown in black and the red dots indicate the likely presence of fires.

In the images on the preceding pages, to the north, accessible by shipping through the narrow and vital Bosporus Strait, are the strange waters of the Black Sea.

To the south, through the critically important Dardanelles (known in ancient times as the Hellespont), lies the historically renowned Aegean Sea.

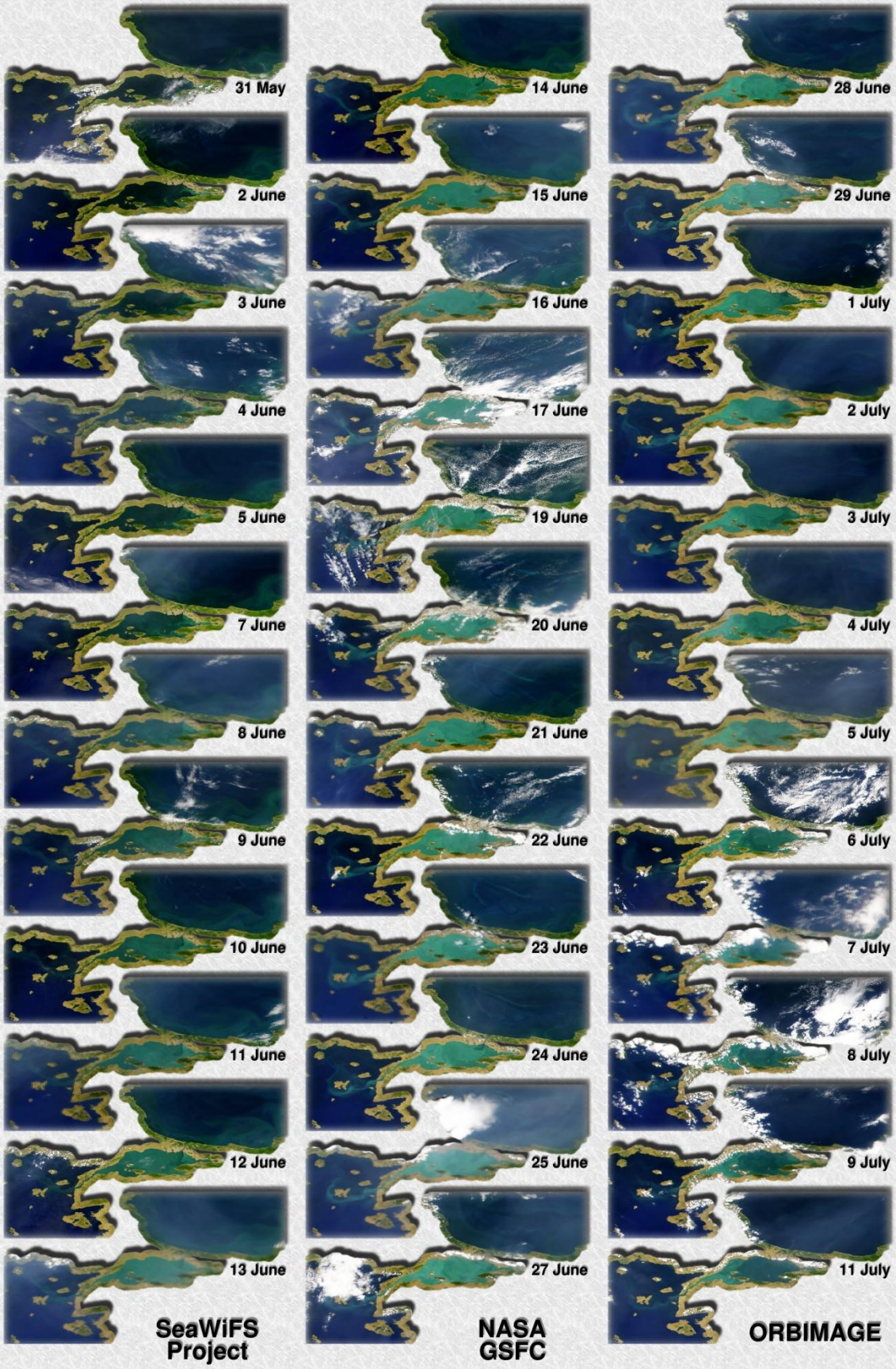
In between, and perhaps somewhat ignored, is the Sea of Marmara, which gets its name from the Greek word for *marble*. The Sea of Marmara is an important link for shipping between the Mediterranean and the Black Sea (including tankers of oil from Russia, which figured in the plot of a James Bond movie titled "The World is Not Enough") but it might seem less significant than other, more familiar bodies of water.

Tranquil scene of the Bosporus as a tanker approaches the entrance to the Black Sea.

As the stunning MODIS images of the Sea of Marmara demonstrate, there is plenty of interest for biological and physical oceanographers to learn about the Sea of Marmara. This single scene portrays some of the intriguing interplay of geography, geology, biology, and physics that occurs in this unique location.

Wondering why the Sea of Marmara is such a bright turquoise color in this image? The answer to that is simple; the color is due to a coast-to-coast bloom of the ubiquitous coccolithophorid species *Emiliania huxleyi.* According to Dr. Temel Oguz—professor in the Institute of Marine Sciences of Middle East Technical University in Icel, Turkey—the Sea of Marmara normally has a three-phase phytoplankton bloom sequence: diatoms in March, dinoflagellates in April, and *E. huxleyi* in May-June, which is similar to the pattern observed in the Black Sea. The MODIS images captured the *E. huxleyi bloom* near its peak. On the next page is a time-sequence of SeaWiFS images showing the development of the *E. huxleyi* bloom in the Sea of Marmara in spring 2003.

Sea of Marmara : 2003



The MODIS image demonstrates how the Sea of Marmara is affected by the physical dynamics of the Black Sea, and how it affects the Aegean Sea. A dark tendril of water is visible emerging from the Bosporus Strait into the Sea of Marmara, indicating the strength of the Black Sea surface outflow. Even more striking is the extension of the Sea of Marmara coccolithophore bloom into the Aegean Sea, demonstrating the influence of the surface current flowing out of the Dardanelles.

These bodies of water are in balance, or else the surface of these seas would be rising or falling if the flow of water into one was not counterbalanced by an approximately equal flow of water out of another. A previous *Science Focus!* article, “Creeping Dead Zones”, includes a schematic diagram of the circulation in the Black Sea. The surface flow out of the Black Sea and the Sea of Marmara into the Aegean Sea (and eventually the Mediterranean Sea), is approximately 600 cubic kilometers per year. This flow is balanced by an annual input of 300 cubic kilometers of water from rivers entering the Black Sea, notably the Danube River, and a roughly equivalent subsurface return flow of more saline Mediterranean Sea water. As the denser water from the Mediterranean flows back into the Black Sea, it sinks, maintaining the "stratification" (density layering) of the water column and the oxygen-free state of the Black Sea depths. The surface layer of the Black Sea is considerably less saline than the salinity of the Mediterranean due to the freshwater input from rivers.

The low-salinity inflow of water from the Black Sea and the Sea of Marmara, illustrated by the plume of coccoliths, is very important to the physical oceanography of the Aegean Sea. The movement of this water, which remains at the surface due to its lower density, can be tracked through the Aegean into the Mediterranean Sea.

Finally, regarding the mythical and historical importance of the Dardanelles and the Sea of Marmara: the ancient city of Troy commanded the approach to the Dardanelles, which made it a vital and wealthy trading port and a sea link to Byzantium (Constantinople/Istanbul). Even though mythology attributes the main cause of the Trojan War (if it occurred—ancient historians are not totally in agreement about that) to a dispute over an extraordinarily lovely woman named Helen, the more likely economic cause was the desire of the Greek kingdoms to remove the dominance of Troy over the sea trade lanes to the Black Sea, through the Sea of Marmara.

Acknowledgments

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Links

Black Sea Circulation and Ecosystem Dynamics

High resolution simulations on the North Aegean Sea seasonal circulation (PDF)

OCTS Europe, June 21, 1997
OCTS images of the Adriatic, Aegean, and central Mediterranean Sea, June 21, 1997, showing remarkable extent of outflow from the Sea of Marmara into the Aegean delineated by coccolithophores

Introduction to the Trojan War (with images of Troy excavations)

Geologists show that Homer got it right

New Tools to Explore Troy

Ancient Troy