Iron dissolved by air pollution may increase ocean potential to trap carbon

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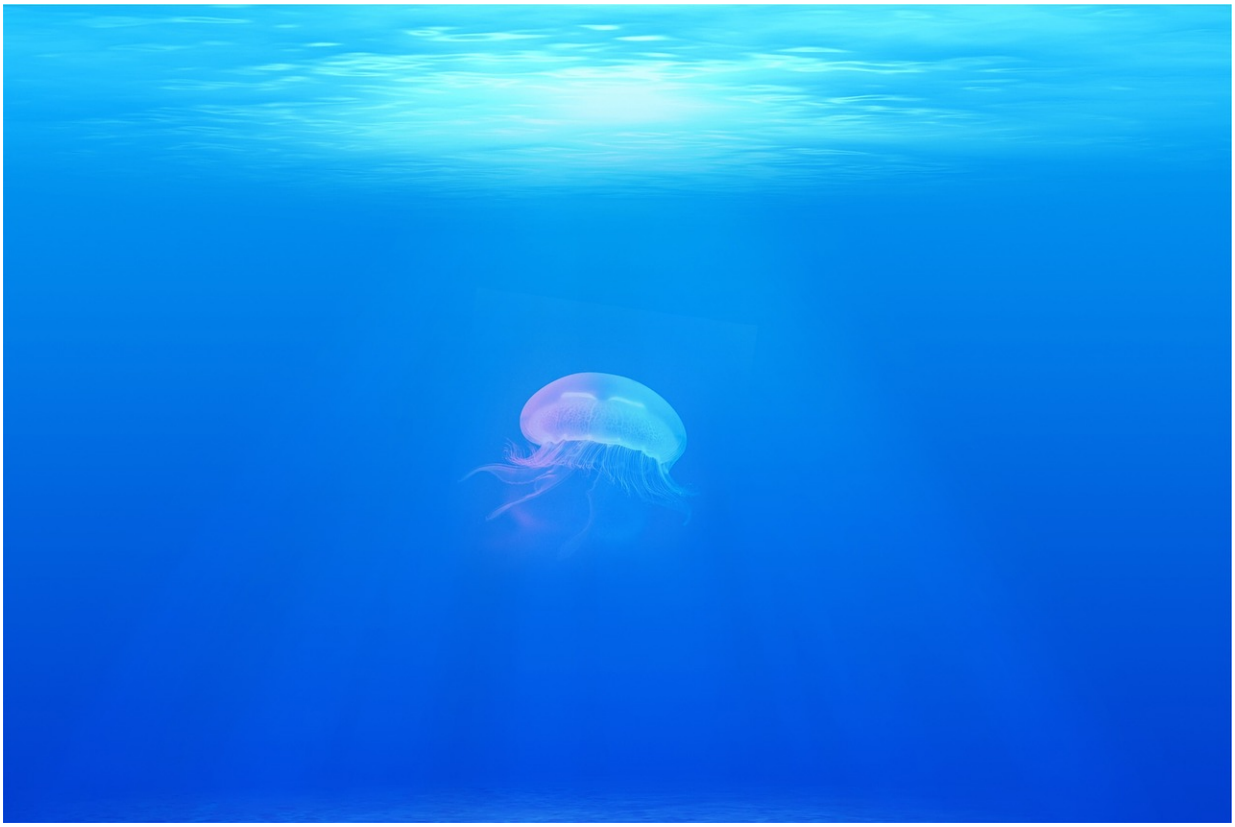

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Iron particles generated by cities and industry are being dissolved by man-made air pollution and washed into the sea - potentially increasing the amount of greenhouse gases that the world's oceans can absorb, a

new study suggests.

Scientists have long believed that acids formed from human-generated pollution and natural emissions dissolve iron in airborne particles - increasing the amount of iron to the ocean - but have lacked direct evidence to prove this theory.

Now, iron-rich particles from steel manufacturing and coal burning, collected in the East China Sea, have been found to have a thick sulphate coating containing soluble iron that provides the 'smoking gun' to prove the theory of acid iron dissolution.

Scientists at the University of Birmingham (UK) and Shandong University (China) led an international research partnership with counterparts from universities in US and Japan. The work was funded by the Natural Science Foundation of China and the UK's Natural Environmental Research Council. The team published their findings in *Science Advances*.

Dr Zongbo Shi, the corresponding author of this work, at the University of Birmingham said: "Air pollution dissolves iron in aerosols, which may help to fertilize the oceans. We know that air pollution seriously damages human health and terrestrial ecosystems but this 'new' source of soluble iron can potentially increase the amount of carbon dioxide stored in the oceans and, thus, inadvertently offset global warming."

Professor Weijun Li, the lead author of this work, at Shandong University added: "The detection of iron sulphate mixed within the sulphate coatings which we analysed provides the 'smoking gun' for acid dissolution because there is no other atmospheric source or process that leads to its formation."

Scientists collected three types of iron-bearing particles from the Yellow

Sea, the northern part of the East China Sea located between mainland China and the Korean Peninsula. Sophisticated microscopic instruments were used to look for iron-containing nanoscale particles - specifically locating them from thousands of aerosol particles.

Researchers showed that iron-rich, fly ash, and mineral dust particles had travelled from the Asian continent. Most of the iron-rich and fly ash particles contained a significant amount of sulphate containing soluble iron.

Most atmospheric sulphur dioxide in East Asia is emitted from coal combustion and industry, whilst the bulk of sulphate particles in the Northern Hemisphere are formed from sulphur dioxide caused by human activities.

The research team, thus, confirmed that the iron rich sulphate particles found in the Yellow Sea are formed by contact with man-made sulphur dioxide. The research shows that the airborne particles became acidic after being transported to the Yellow Sea.

"Human activities may have led to an increase of atmospherically soluble iron in the oceans by several times since the Industrial Revolution, which could have a major impact on how effective our oceans are regulating our climate," added Dr Shi.

"Controlling air pollution will bring huge benefits to human welfare but it may reduce the amount of nutrients to the surface ocean and, thus, the ocean carbon uptake rate. More work needs to be done to quantify the impact of anthropogenic soluble iron on ocean ecosystems and climate."

More information: "Air pollution–aerosol interactions produce more bioavailable iron for ocean ecosystems," *Science Advances*, advances.sciencemag.org/content/3/3/e1601749