

# Salinity bias with negative pressure dependency caused by anisotropic deformation of CTD measuring cell under pressure examined with a dual-cylinder cell model

\*Taiyo Kobayashi<sup>1</sup>

1. Japan Agency for Marine-Earth Science and Technology

Measurements made by deep floats had a salinity bias with a negative pressure dependency. Salinity is affected by conductivity measurements via changes in the CTD measuring cell geometry under pressure. To remove the effect, a canceling factor for pressure  $CP_{cor}$  is prepared theoretically by the manufacturer considering the isotropic deformation of a single-cylinder measuring cell under pressure; the observed negative pressure dependency, however, requires an even smaller  $CP_{cor}$ . This study examined the causes of the inconsistency for salinity measurements with a dual-cylinder cell model, considering that the actual CTD measuring cell is a glass cell covered by a polyurethane jacket. The dual-cylinder cell model clarifies that the CTD measuring cell deforms anisotropically to yield a smaller  $CP_{cor}$ ; mainly because the inner glass cell deforms radially to a greater extent than the single-cylinder model due to the radial stress from the outer cylinder (jacket) being stronger than the hydrographic pressure. The observed fresh bias at the sea surface is attributed to a slight shrinkage of the outer jacket because of compression set of polyurethane in deep ocean. The shrunken polyurethane jacket is elongated over time due to a creep phenomenon, which causes less-freshening of the fresh bias found at the sea surface. The observed linear relationship between the smaller  $CP_{cor}$  and the fresher bias at the sea surface is attributed to the variation of the wall thickness of the polyurethane jacket when it shrinks similarly. The study suggests another idea to improve the salinity accuracy of CTD sensors greatly: a change of the jacket material into an elastomer. The improvement makes the present setting of  $CP_{cor}$  be more valid and reliable, because the elastomer jacket hardly affects the change of the measuring cell geometry under pressure, which in turn removes the pressure effects on salinity measurements.

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