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Short Communication

Study of Sound Propagation in the Sea Water (Case Study: Persian Gulf)

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Abstract

The Persian Gulf in south of Iran is important strategically why is used for fisheries, shipping and some other application. Sound channels as a physical phenomenon is studying in all of water surface, why it is used in marine science such as military. This subject has been studied and considered in the Persian Gulf and to some extend in the Oman Sea. This event happens in the Persian Gulf seasonally, but it takes place there weakly, because this water basin is a shallow water resource. Of course forming seasonal and weak sound channel in the Persian Gulf will be compared with in the Oman Sea. It could be seen that sound channel formation in the Oman Sea happens strongly due to that it happens in deep water basins contemporarily.

Keywords: Sound, velocity, propagation, profile, Persian Gulf.

Introduction

Existence of sound channel in a water basin as a sea or ocean shows that sound rays could move through an artificial channel as a supposing applied channel underwater[1]. In fact where sound rays behaviorism as mechanical waves in a separate channel having upper and downfall walls under surface represents detecting obstacles and purposes in water by using sound propagation instruments. Sound is defined as a voice created from strike of two or more things. It passes a distance of some or several kilometers in the space of sound propagated from a sound instrument. Of course sound waves as some rays damp through the space propagating and moving in[2]. It is expressed by Clay and Medwin and Tafrishi that sound channel existence and in the Persian Gulf could be formed there, but seasonally[3]. This result was obtained in the Persian Gulf and the Strait of Hurmoz and also expressed by Mosaddad[4]. Sound velocity in the water depends on water temperature and salinity and also pressure through water in deep of sound propagation. Of course it depends more on temperature, particularly[5].

Material and Methods

Sound velocity: Sound waves as mechanical one are propagated through a space like in air or water depending on physical and to some extend chemical properties of material of space or inter mediator environment. Sound velocity is about 33104 ($^{m}/_{s}$) in air depending on air humidity and its impurities changing a little and this value is 4.5 to 5 times of the above value for seawaters[6].

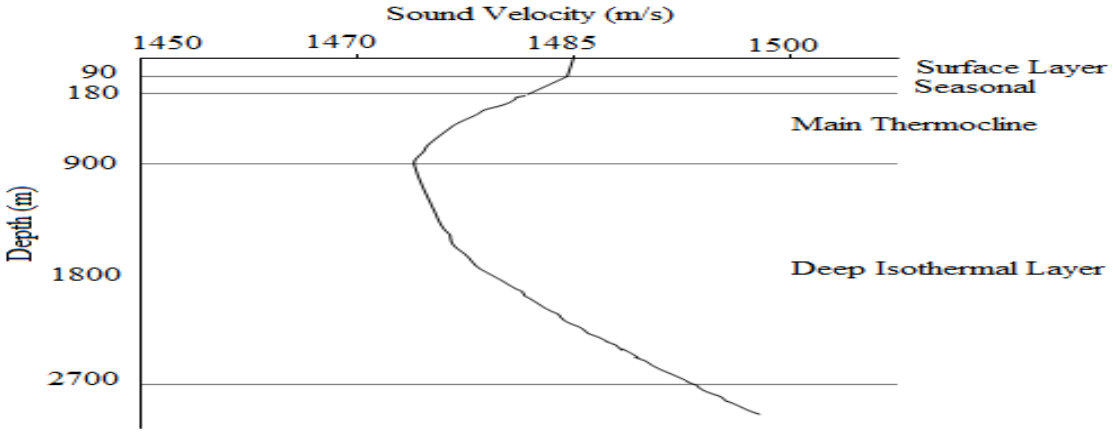

Figure-1
Sound velocity in northern part of Persian Gulf (1998 July)

Sound waves could be absorbed by particles and objects in the space that are moving and so could be scattered because these mechanical ones. Damping of these waves happens during propagating through the inter mediator material or space. Sound velocities in different materials and space differ from each others; even it is equal for in different types of a material[7]. For example, sound velocities in drink, river and sea waters are not equal, why physical and some chemical properties of water samples in these types differ from each other. Salinity, as an important physic- chemical in different watery, while it is zero in drink water. A sample of recorded sound velocity in Persian Gulf is shown as figure 1.

Deep Sound channel: Where the negative gradient of the main thermocline meets the positive gradient of the deep isothermal layer, a sound channel called the "deep sound channel" is created. Deep Sound Channels occur in most deep ocean basins. In the deep sound channel, sound traveling near the deep sound channel axis is continually bent back towards the axis and can travel down the axis for many miles[8]. Above the depth of the axis of the deep sound channel, the temperature of the water has the most significant affect on sound velocity. As the water gets deeper, it reaches a steady temperature of 2-4^{0}C at deep depths. Since the temperature is not changing, below the sound channel axis, pressure has the dominant affect on sound velocity. Thus as you go further down in depth, pressure increases and so does sound velocity. Hence the positive gradient of the sound velocity below the deep sound channel axis. If the sound source is close to the channel axis (minimum c), acoustic rays are successively refracted by the two gradients without interacting with the interfaces. This type of propagation is called SOFAR (sound fixing and ranging). It allows for very large transmission ranges because of the absence of energy loss by reflection at the interfaces and concentration of a large number of multiple paths, thereby minimizing geometric spreading. We can achieve ranges of several thousands of kilometers by using low frequencies[9].

Also sound propagation in sea water has another application in topography and taking photos of basin bottom. By this, topography of the basin bottom would be appointed and studied; changes in depths of water basin are appointed and it will be studied because of an important application, therefore sedimentation and bottom destruction could be rated accurately. Sound channels could be formed in all deep water and Ocean. It could be observed that sound channels are not formed in some shallow water basins. In other shallow waters such as the Persian Gulf the sound channels usually form weakly. The Oman Sea as the start of connecting the Gulf to the oceans and surface waters on the earth is a deep basin with an average depth more than 1500 meters. Past research and studies have shown that sound channels form in the Oman Sea. In fact sound waves propel through sea water basin happens as some rays moving in a channel underwater. They suffer absorption and so scattering by impurities, salinities and obstacles in the water[10].

Results and Discussion

Doing this research was performed by using NOAA data collection through the Persian Gulf, the Strait of Hormoz and some measurement stations in the Oman Sea. The profiles of sound velocity vertically from water surface to bottom in the above three locations are drawn as the following figures.

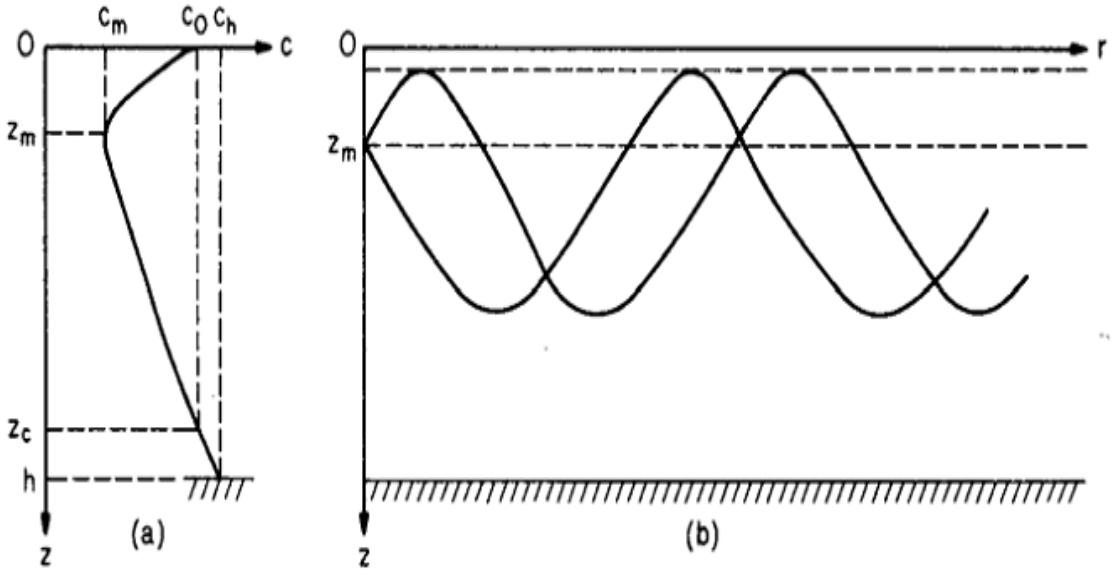

Figure-2
A Typical Underwater Sound Channel

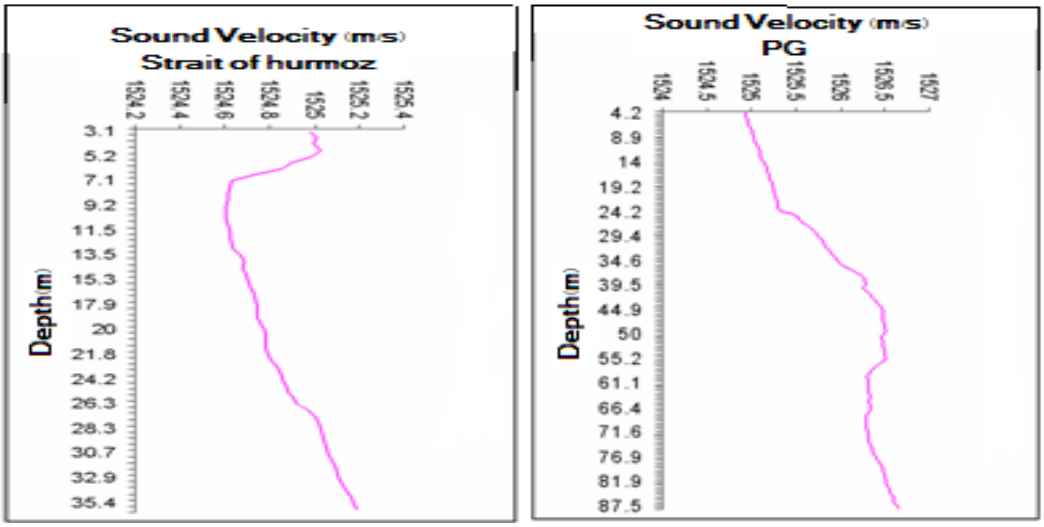

Figure-3
Sound velocity profiles through the PG and Strait of Hormoz

Conclusion

Being accurate about this research and similar ones we could say that sound channels could form more in deep waters and weakly in shallow waters, this applied and useful result could be obtained for the Persian Gulf and the Oman Sea. This phenomenon happens more seasonally. By using these results and acoustical instruments, it could be applied usefully to reach to some applicable and trade finding. This concept will be illustrated informing underwater environment by propagating sound waves and analyzing them.

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