

A HISTORY OF THE IRAPETRA GYRE.

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Abstract

A combined POEM-Russian data base allowed us to follow the detailed history of the Irapetra Gyre between 1987 and 1995, when, according to some reports it disappeared. Throughout this period, we describe the changes in intensity, size, and position of the Irapetra Gyre. The examination of previous investigations as well as a thorough search through the data of Med Atlas I indicated that the Irapetra Gyre may have occurred earlier than the POEM description. Examination of satellite data indicates that Irapetra was present after 1995.

Key words: Eastern Mediterranean circulation, Cretan Passage circulation, Irapetra Gyre.

Two large scale investigations of the Eastern Mediterranean: POEM, an international cooperative effort, and GOIN, an initiative of the former USSR, were carried out between 1985 and 1995. The two were integrated into PGDB, a combined Poem Goin Data Base (1).

A very conspicuous feature on the PGDB maps is the Irapetra anticyclonic gyre situated South-South-East of Crete. This gyre was discovered by two independent cruises: the POEM 05 cruise of August-October 1987 (2) and the Gakkel 29 cruise of September-October 1987 (3, 4), as well as by drifter buoy and satellite thermal imagery (5). Each of the investigators called this gyre by a different name, however it seems that by now Irapetra is the accepted name. The gyre was not observed during March-April 1986 (2), and there is no data for the summer of 1986. The amalgamation of POEM 04 (February-May 87) with Gakkel 28 (March-April 87) proved conclusively that, indeed, there was no Irapetra Gyre during the winter of 1987 (1).

Gakkel 31 (February-April 88) does not provide sufficient information for a definite statement about the presence of the Irapetra Gyre, and none of the POEM 06 (July-August 88) stations were located in the Cretan Passage. According to Popov *et al.* (4) the Passat 56 cruise, shows the Irapetra during the summer of 1988 but we do not have this data. The Irapetra gyre is clearly depicted during the winter of 1989 (Gakkel 33 and LBDS01 cruises), and the summer of 1989 (Parshin 02 cruise), the winter of 1990 (Gakkel 36), the summer of 1990 (Gakkel 38 together with Parshin 06 and LBDS02). We do not have any data for the winter of 1991, but we do have the Irapetra Gyre in the data of POEMBC during the summer of 1991. There is no data between POEMBC and the LIWEX cruise of 1995 where we can clearly see the Irapetra Gyre. From 1987 to the fall of 1995, the Irapetra was also discovered, followed and investigated by La Violette *et al.* (6) via drifter buoy and satellite thermal imagery. According to La Violette *et al.* (6) the Irapetra Gyre can not be found in the satellite imagery after 1995, and they conclude that the gyre has dissipated.

Irapetra is described as permanent seasonal feature of the Eastern Mediterranean summer circulation by Popov *et al.* (4) and although they did observe the gyre during the winter of 1990 (Gakkel 36), they suggest that this is either a remnant from the previous summer or the initial beginning of the gyre of the following summer. However, the same gyre as described by La Violette *et al.* (6) appears to be a large and very intensive gyre. Apparently, the Gakkel 36 stations were not sufficiently dense nor sufficiently extensive to give a proper description of the gyre.

We conclude that the Irapetra Gyre was present almost continuously from its discovery in 1987 to 1995, the last of our data. Its position and intensity varies seasonally, it is smaller in the winter than in the summer and by and large, each summer it was larger than during the previous one. Its intensity reached its peak during the summer of 1990. Its size reached its peak during the summer of 1991, when the Irapetra reached almost to the middle of the Cretan Passage and down to about 700 m, displacing (downward) both the MAW and the LIW.

One of the intriguing questions regarding the Irapetra Gyre is whether summer 1987 is really the first time it appeared or only the first time it was noticed.

The Cretan Passage was investigated during the six R/V *Vavilov* Mediterranean cruises (1959 to 1963). Unfortunately, this data is not available. The R/V *Vavilov* results, [Figs. 60 and 61 in (7)] indicate the presence of an anticyclonic feature South-South-East of Crete, sometimes in the winter (January 1962) and sometimes in the summer (September-October 1959, May 1962, and October-November 1963). Fig. 61 [in (7) also] presents an analysis of the data from R/V *Atlantis* (April-May 1948), which shows a cyclonic feature south of Crete, and the data of R/V *Calypso* (September-October 1956), which shows an

anticyclonic feature South-South-East of Crete. However, the station distributions of the cruises indicate that the R/V *Vavilov* stations were not dense enough to reveal the size and the intensity of mesoscale features, and the stations of the R/V *Atlantis* or the R/V *Calypso* were even sparser.

A careful search of the MEDATLAS 1 Data Base revealed that, although many of the cruises, preceding the POEM project, occupied some stations in the Cretan Passage none of those stations were dense enough to map the Irapetra Gyre. Nevertheless, some of those stations, indicated that the region of the Irapetra Gyre was warmer than its surroundings both in the winter as well as in the summer. Thus we are led to the conclusion that, in all probability, the Irapetra Gyre was present in the region for a long time and it was revealed only thanks to the detailed investigation of POEM and GOIN. On the available evidence it would appear that the Irapetra Gyre is not a permanent feature but a recurring one.

The formation of the Irapetra Gyre was related to the outflow from the Aegean (6, 3). Its exceptional intensification during the summers of 1989 and 1990 was related to the anomalous intensive outflow of Aegean water via the Kassos and Karpathos passages (3). However, no other report, and in particular (8) who investigated this outflow extensively, seems to have made this connection.

Oceanographic Features Analysis maps of the Naval Oceanographic Office show the Irapetra distinctively both in the summer and in the winter.

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