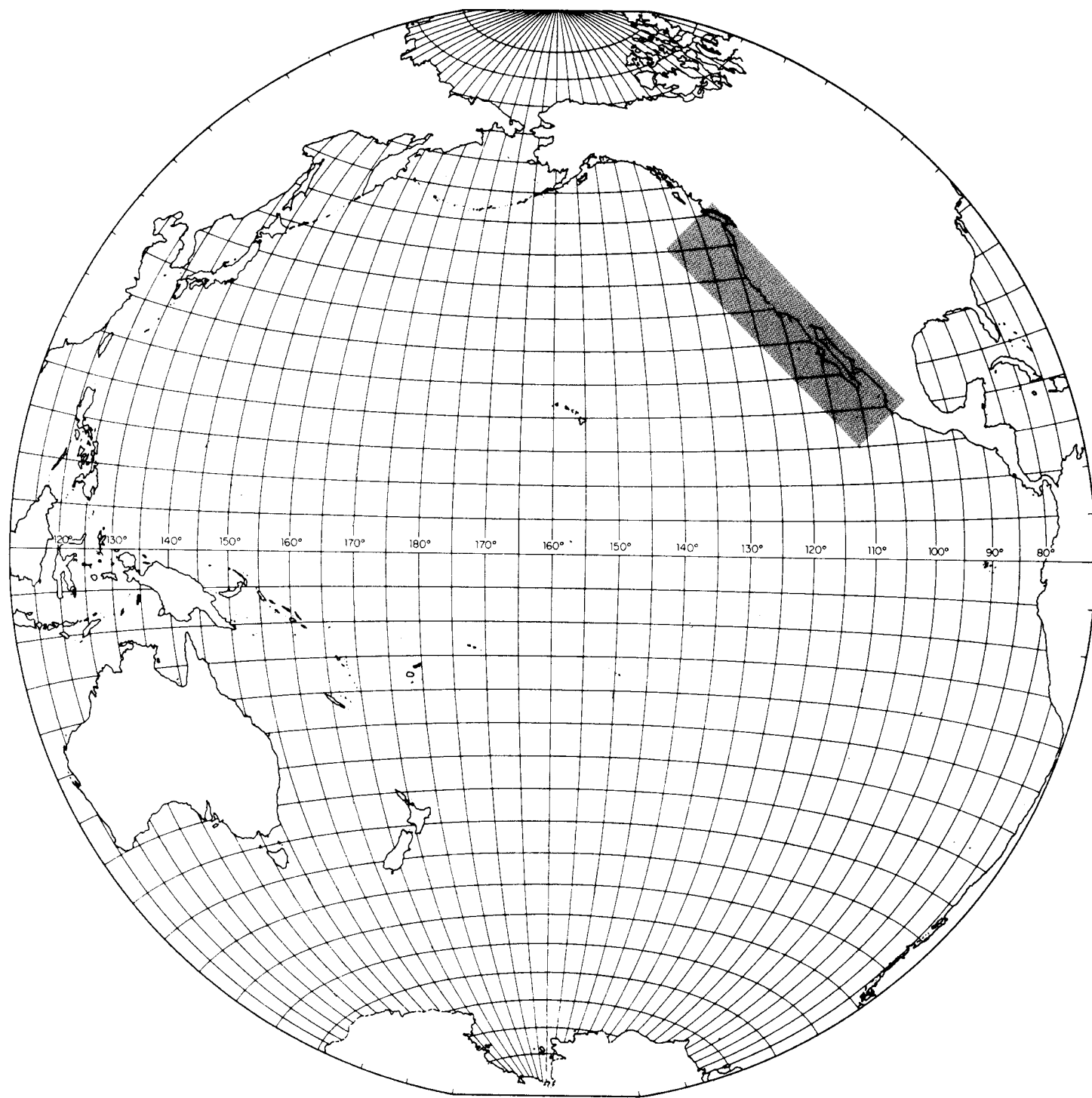


STATE OF CALIFORNIA  
MARINE RESEARCH COMMITTEE



# CALIFORNIA COOPERATIVE OCEANIC FISHERIES INVESTIGATIONS

ATLAS No. 4

CALIFORNIA  
COOPERATIVE  
OCEANIC  
FISHERIES  
INVESTIGATIONS

*Atlas No. 4*

STATE OF CALIFORNIA  
MARINE RESEARCH COMMITTEE

*Cooperating Agencies:*

CALIFORNIA ACADEMY OF SCIENCES  
CALIFORNIA DEPARTMENT OF FISH AND GAME  
STANFORD UNIVERSITY, HOPKINS MARINE STATION  
U. S. FISH AND WILDLIFE SERVICE, BUREAU OF COMMERCIAL FISHERIES  
UNIVERSITY OF CALIFORNIA, SCRIPPS INSTITUTION OF OCEANOGRAPHY

December, 1966

THE CALCOFI ATLAS SERIES

This is the fourth in a series of atlases containing hydrographic and plankton data from the region of the California Current. The field work was carried out by the California Cooperative Oceanic Fisheries Investigations,<sup>1</sup> a program sponsored by the State of California under the direction of the State's Marine Research Committee. The cooperating agencies in the program are:

California Academy of Sciences  
California Department of Fish and Game  
Stanford University, Hopkins Marine Station  
U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries  
University of California, Scripps Institution of Oceanography

CalCOFI atlases<sup>2</sup> are issued as individual units as they become available. They provide processed physical, chemical and biological measurements of the California Current region. Each number may contain one or more contributions. A general description of the CalCOFI program with its objectives appears in the preface of Atlas No. 2.

This atlas was prepared by the Data Collection and Processing Group of the Marine Life Research Program, Scripps Institution of Oceanography.

CalCOFI Atlas Editorial Staff:

Abraham Fleminger and Hans T. Klein, Editors  
John G. Wyllie, Principal analyst, physical-chemical oceanographic data

Atlases in this series are:

CalCOFI Atlas No. 1

Anonymous. CalCOFI atlas of 10-meter temperatures and salinities 1949 through 1959.

CalCOFI Atlas No. 2

Fleminger, A. Distributional atlas of calanoid copepods in the California Current region, Part 1.

CalCOFI Atlas No. 3

Alvarino, A. Distributional atlas of Chaetognatha in the California Current region.

CalCOFI Atlas No. 4

Wyllie, J. G. Geostrophic flow of the California Current at the surface and at 200 meters.

<sup>1</sup> Usually abbreviated CalCOFI, sometimes CALCOFI or CCOFI.

<sup>2</sup> For citation this issue in the series should be referred to as CalCOFI Atlas No. 4.

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GEOSTROPHIC FLOW OF THE CALIFORNIA CURRENT  
AT THE SURFACE AND AT 200 METERS

John G. Wyllie<sup>1</sup>

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Introduction

In this atlas attention is directed to the geostrophic flow at the surface and at 200 meters<sup>2</sup> relative to currents at 500 meters as computed from temperature-salinity-depth data.

More than 280 charts have been prepared covering the period from early 1949 through the spring of 1965 (Fig. 1). These charts bring together most of the data available on the geostrophic flow of the California Current. Future research into the behavior of this current system, so vital for a full understanding of the eastern North Pacific Ocean, should be aided by this compilation of charts.

For readers not acquainted with the term geostrophic flow, the following comment is offered. The geostrophic flow, calculated from temperature-salinity-depth data, provides a reliable approximation of the actual motion of the water when this motion is considered over a period of time of a day or more. Forces which result in shorter-term current variations are omitted from the calculations. An example would be the tidal forces. The current measured at any particular moment can differ widely from the geostrophic flow, but the resultant of a series of measurements

<sup>1</sup> Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California.

<sup>2</sup> The terms meters and decibars (db) can be used interchangeably for practical purposes. For example, the pressure at a depth of 200 meters is very close to 200 decibars, so the more familiar term meters is used although decibars, a pressure term, is correct.

taken over a period of time will tend to approach the geostrophic flow (Reid and Schwartzlose, 1962; Reid, Schwartzlose and Brown, 1963). As a result, for example, the drift of plankton may better be estimated from the geostrophic flow than from an instantaneous current measurement.

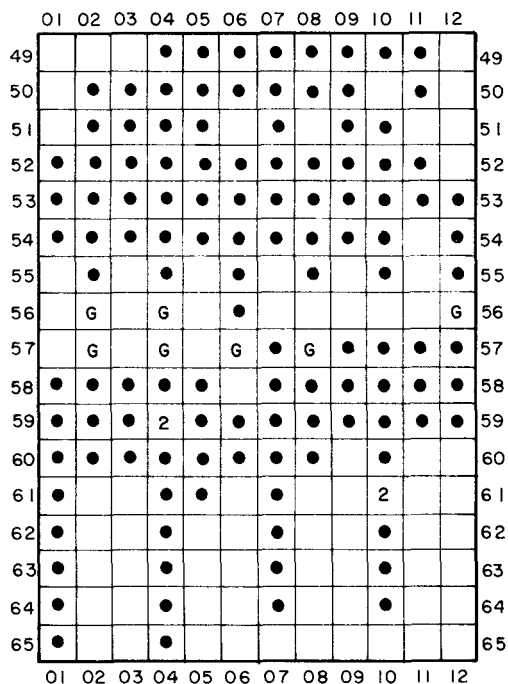


Figure 1. Months for which cruise charts are available. Key to the boxed index: The numbers for the rows (years) combined with those for the columns (months) form the cruise numbers.

- = 0/500 and 200/500-db charts
- 2 = the same as ● but two cruises this month
- G = 0/500 and 200/500-db charts with the Gulf of California included

### Analysis of Charts

In the analysis of the charts only data published in OCEANIC OBSERVATIONS OF THE PACIFIC, which contain data for the years 1949 through 1959 (Scripps Institution of Oceanography, various years of publication), and in subsequent final data reports of the CalCOFI program were used. The final analysis of each chart

was checked against charts adjacent in time, against corresponding charts from other years and against the monthly means. Contouring, being subjective by nature, cannot be done without alternative possibilities presenting themselves. Some decisions can be supported with rational arguments but some are arbitrary and their validity depends upon the judgement and experience of the analyst.

Monthly mean charts for both the surface and 200 meters are included. The station values upon which the contours are based are simple arithmetic means of observed data with no attempt made to fill in missing data with interpolated values.

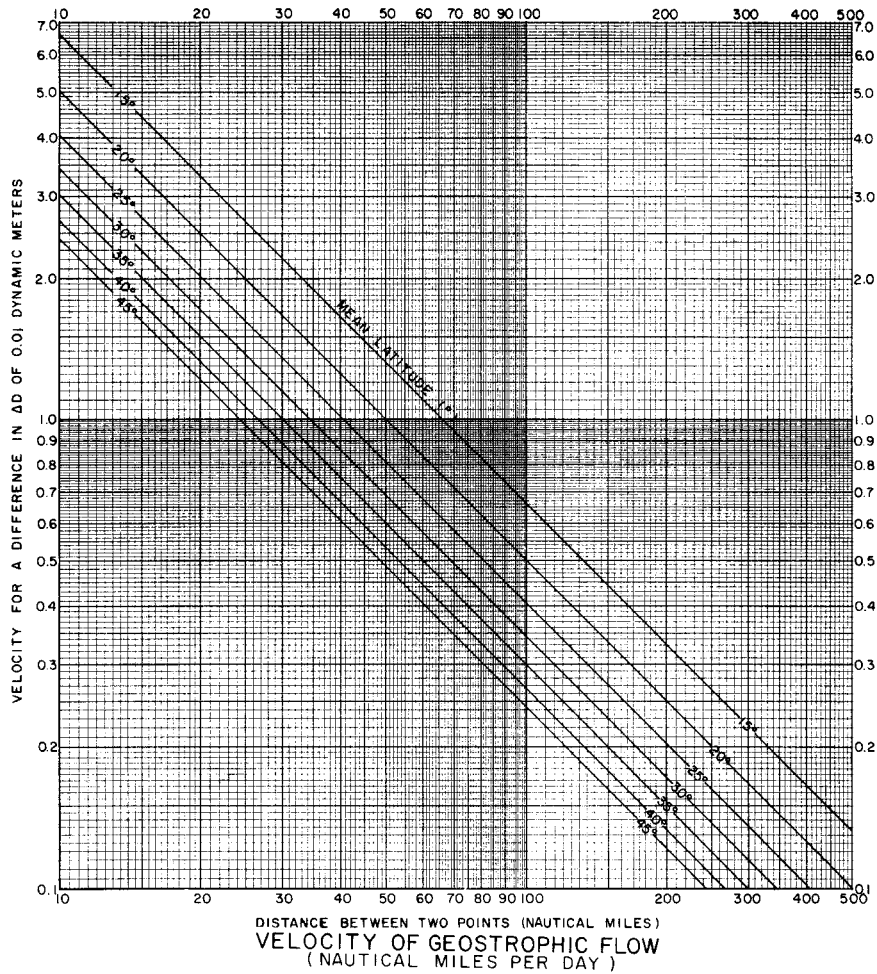
In addition, a chart of 500 over 1000 db and one of 1000 over 2000 db is included. The data for these were carefully checked and the salinity data were determined by salinometer. These charts are presented for the purpose of estimating the validity of the 500 meter (decibar) level as a time-independent, zero-velocity, reference plane. The 1000 over 2000-db chart indicates little or no motion at a depth of 1000 meters relative to 2000 meters. Motion is indicated, however, at 500 meters relative to 1000 meters. Since the charts of the atlas are referred to 500 db and not 1000 db, a correction factor can be applied, if desired, as indicated on the 500 over 1000-db chart. This correction will usually intensify the flow a small amount.

The contour interval on the 200 over 500-db charts is 0.02 dyn. m but 0.04 dyn. m on the 0 over 500-db charts.<sup>1</sup> This convention must be remembered when calculating speed from the chart contours; otherwise, the current speeds will be in error. Figure 2 provides a convenient graph and conversion table for estimating current speed. It is a modification of a graph developed by G. I. Roden (unpublished).

### Basic Pattern of the California Current

This work reflects moderately scaled features of the oceans, i. e., features whose minimum size is of the order of tens of miles in contrast to features whose minimum size is of the order of hundreds of miles or, in the other direction, hundreds of feet. Coastal currents very near shore may not be reflected in the data because of this scale problem or because other factors, not included in the calculation of geostrophic flow, are dominant in the immediate coastal regions. It should also be realized that the majority of charts reflect conditions only in the eastern portion of the California Current since cruises seldom covered the entire region in any given month.

<sup>1</sup> Dynamic meters (dyn. m) is an oceanographic expression of work per unit mass and depends upon the units used for length and time. When the length is expressed in meters and the time in seconds the unit of work per unit of mass is the dynamic decimeter. The unit used is the dynamic meter.



cm/sec	0	1	2	3	4	5	6	7	8	9
0	<i>KNOTS</i> 0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.17	
	0.47	0.93	1.40	1.86	2.33	2.80	3.26	3.73	4.20	
10	0.19	0.21	0.23	0.25	0.27	0.29	0.31	0.33	0.35	0.37
	4.66	5.13	5.59	6.06	6.53	6.99	7.46	7.93	8.39	8.86
20	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.52	0.54	0.56
	9.32	9.79	10.26	10.72	11.19	11.66	12.12	12.59	13.05	13.52
30	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72	0.74	0.76
	13.99	14.45	14.92	15.38	15.85	16.32	16.78	17.25	17.72	18.18
40	0.78	0.80	0.82	0.84	0.85	0.87	0.89	0.91	0.93	0.95
	18.65	19.11	19.58	20.05	20.51	20.98	21.45	21.91	22.38	22.84
50	0.97	0.99	1.01	1.03	1.05	1.07	1.09	1.11	1.13	1.15
	23.31	23.78	24.24	24.71	25.17	25.64	26.11	26.57	27.04	27.51
60	1.17	1.18	1.20	1.22	1.24	1.26	1.28	1.30	1.32	1.34
	27.98	28.44	28.90	29.37	29.84	30.30	30.77	31.24	31.70	32.17
70	1.36	1.38	1.40	1.42	1.44	1.46	1.48	1.50	1.52	1.53
	32.63	33.10	33.57	34.03	34.50	34.96	35.43	35.90	36.36	36.83
80	1.55	1.57	1.59	1.61	1.63	1.65	1.67	1.69	1.71	1.73
	37.30	37.76	38.23	38.69	39.16	39.63	40.09	40.56	41.03	41.49
90	1.75	1.77	1.79	1.81	1.83	1.85	1.86	1.88	1.90	1.92
	41.96	42.42	42.89	43.36	43.82	44.29	44.76	45.22	45.69	46.15
100	1.94	1.96	1.98	2.00	2.02	2.04	2.06	2.08	2.10	2.12
	46.62	47.09	47.55	48.02	48.48	48.95	49.42	49.88	50.35	50.82

CONVERSION TABLE  
(CENTIMETERS / SECOND - KNOTS - NAUTICAL MILES / DAY)

1 cm/sec = 0.019 kts = 0.466 NAUTICAL MILES / DAY  
 1 kt = 24 NAUTICAL MILES / DAY = 51.48 cm/sec  
 1 NAUTICAL MILE / DAY = 0.042 kts = 2.14 cm/sec

Figure 2. Graph for estimating current speed. Table for converting cm/sec, knots, nautical miles per day.



As there appears to be a large amount of variation within the California Current system great care must be exercised in arriving at general conclusions from "instantaneous" current measurements or even from data collected on a limited number of cruises. A seasonal pattern does exist, but there is considerable year-to-year variation. The variation in strength of the California Current is probably controlled by the strength and the direction of flow of the West Wind Drift at the time it is influenced by the presence of the continent of North America. The monthly mean charts therefore serve only as guidelines to seasonal trends. Some of the trends appear to be as follows: the southward-flowing California Current moves inshore during April-May, eliminating the coastal countercurrent at the surface and, at times, at 200 meters. The coastal countercurrent depends upon this seasonal on-shore-offshore migration of the south-flowing California Current. When offshore, the surface countercurrent develops; when onshore, the surface countercurrent is absent although the Southern California cyclonic eddy usually persists. The California Current begins as the southern branch of the West Wind Drift. Within the area of our charts the first impingement of the California Current on the west coast is found in the vicinity of Cape Mendocino. South-flowing surface water is found in the area most of the year. From this point south the main current swings offshore, except in April-May, turning eastward at 30-33 degrees north latitude and approaches the northern coast of Baja California in the vicinity of Cabo Colnett-Punta Baja.<sup>1</sup> This inshore flow is usually weakest during late summer and late fall, the time when a surface coastal countercurrent is most likely to appear in the region. South of the Cabo Colnett-Punta Baja region the main stream tends to swing offshore. It may turn inshore again somewhere north of Bahia Magdalena but, by this time, it is often indistinct and difficult to identify.

At 200 meters the main south-flowing current is usually farther offshore than at the surface. This may account for the greater persistence of north-flowing water in the deeper portion of the coastal countercurrent.

An atlas of this nature requires the efforts of many people over a long period of time. This atlas is a direct result of the work of the Data Collection and Processing Group at Scripps Institution of Oceanography. The author wishes to thank Joseph L. Reid, Jr., for his advice during the analysis of the many charts, Ronald Lynn for the use of his conveniently tabulated data and Arnold Mantyla for his helpful suggestions in discussions concerning the basic pattern of the California Current.

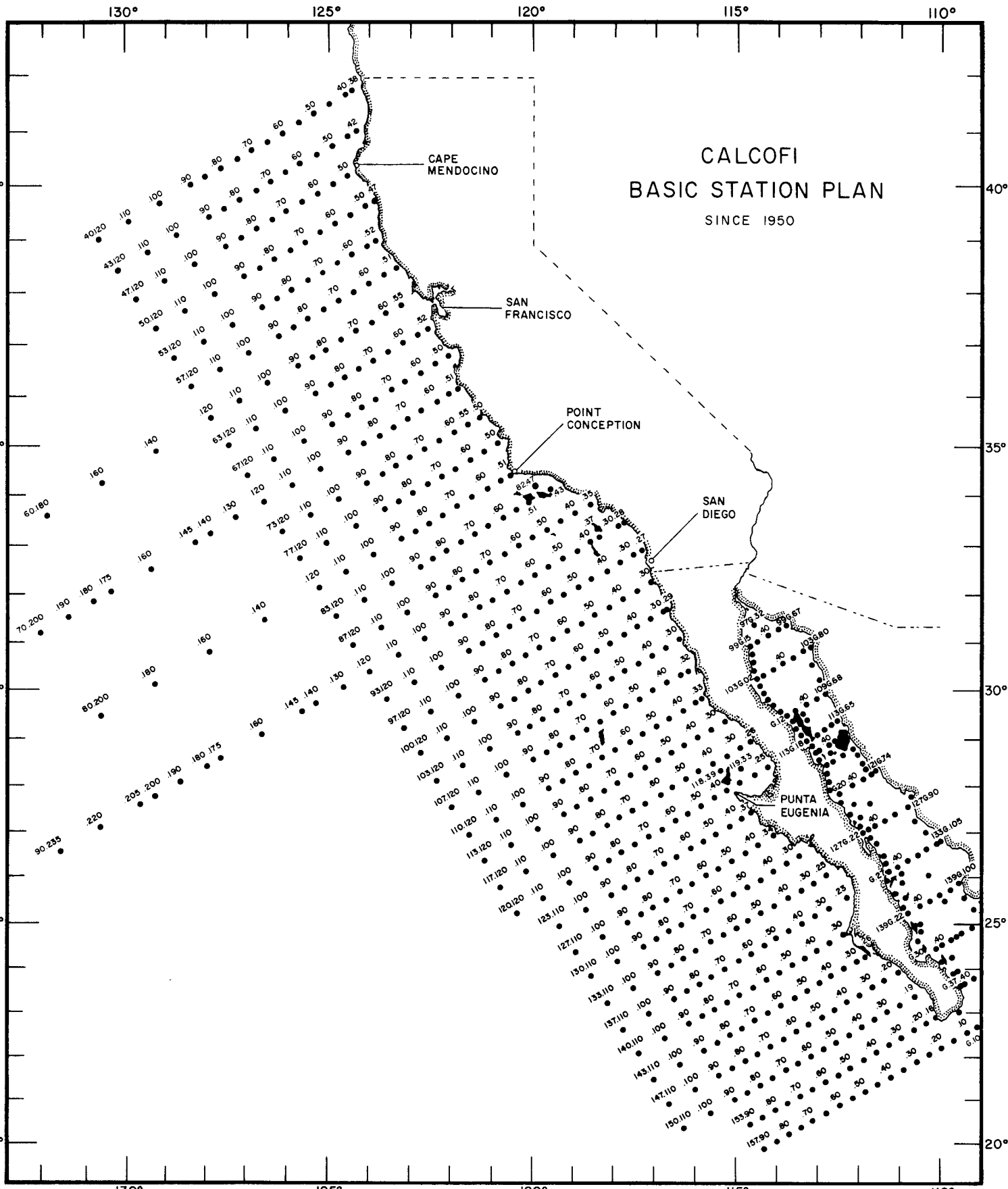
<sup>1</sup> See place-name map on inside of back cover.

## REFERENCES

- Reid, J. L., Jr., and R. A. Schwartzlose, 1962. Direct measurements of the Davidson current off central California. *J. Geophys. Res.*, 67(6): 2491-2497.
- Reid, J. L., Jr., R. A. Schwartzlose, and D. M. Brown, 1963. Direct measurements of a small surface eddy off northern Baja California. *J. Mar. Res.*, 23(3): 205-218.
- Scripps Institution of Oceanography, University of California, 1957. *Oceanic Observations of the Pacific: 1949*. Berkeley and Los Angeles, University of California Press, 363 p.
- \_\_\_\_\_, 1960a. *Oceanic Observations of the Pacific: 1950*. Berkeley and Los Angeles, University of California Press, 536 p.
- \_\_\_\_\_, 1960b. *Oceanic Observations of the Pacific: 1955, the NORPAC Data*. Berkeley and Tokyo, University of California Press and University of Tokyo Press, 582 p.
- \_\_\_\_\_, 1962. *Oceanic Observations of the Pacific: 1955*. Berkeley and Los Angeles, University of California Press, 477 p.
- \_\_\_\_\_, 1963a. *Oceanic Observations of the Pacific: 1951*. Berkeley and Los Angeles, University of California Press, 598 p.
- \_\_\_\_\_, 1963b. *Oceanic Observations of the Pacific: 1956*. Berkeley and Los Angeles, University of California Press, 458 p.
- \_\_\_\_\_, 1965a. *Oceanic Observations of the Pacific: 1952*. Berkeley and Los Angeles, University of California Press, 617 p.
- \_\_\_\_\_, 1965b. *Oceanic Observations of the Pacific: 1953*. Berkeley and Los Angeles, University of California Press, 576 p.
- \_\_\_\_\_, 1965c. *Oceanic Observations of the Pacific: 1954*. Berkeley and Los Angeles, University of California Press, 426 p.
- \_\_\_\_\_, 1965d. *Oceanic Observations of the Pacific: 1957*. Berkeley and Los Angeles, University of California Press, 707 p.

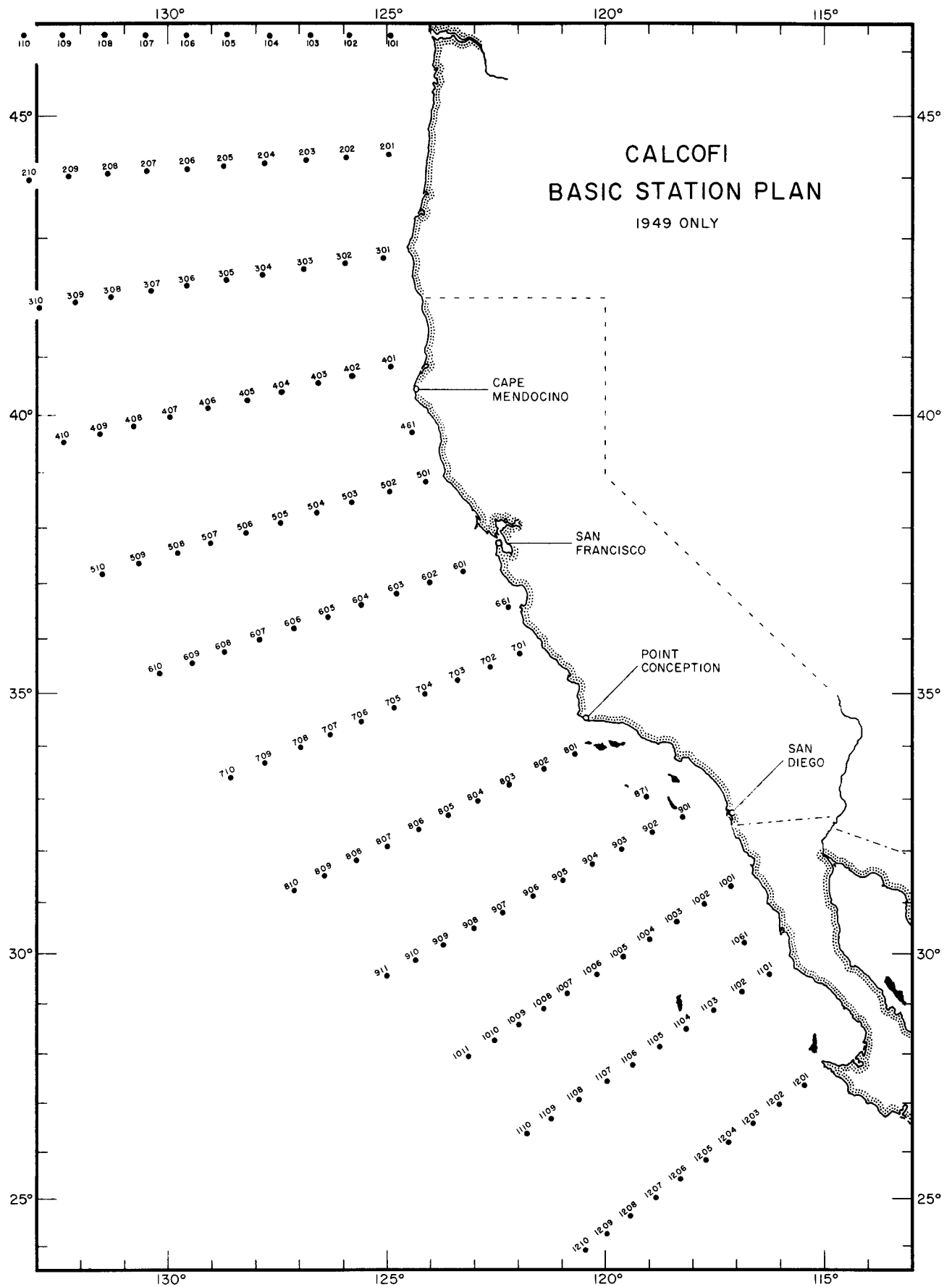
\_\_\_\_\_, 1965e. Oceanic Observations of the Pacific: 1958. Berkeley and Los Angeles, University of California Press, 804 p.

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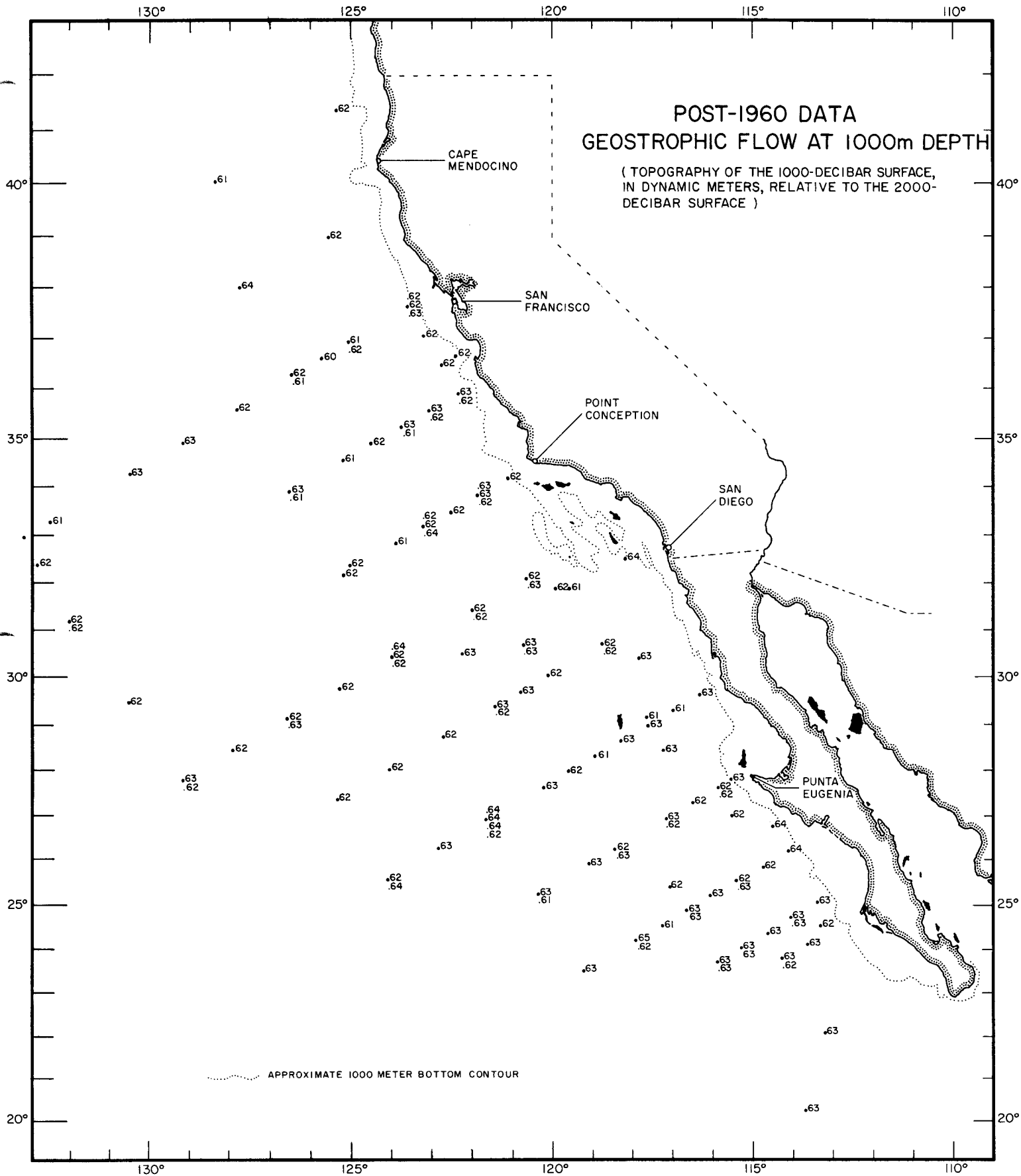
BASIC STATION PLAN  
SINCE 1950



CALCOFI

BASIC STATION PLAN

1949 ONLY

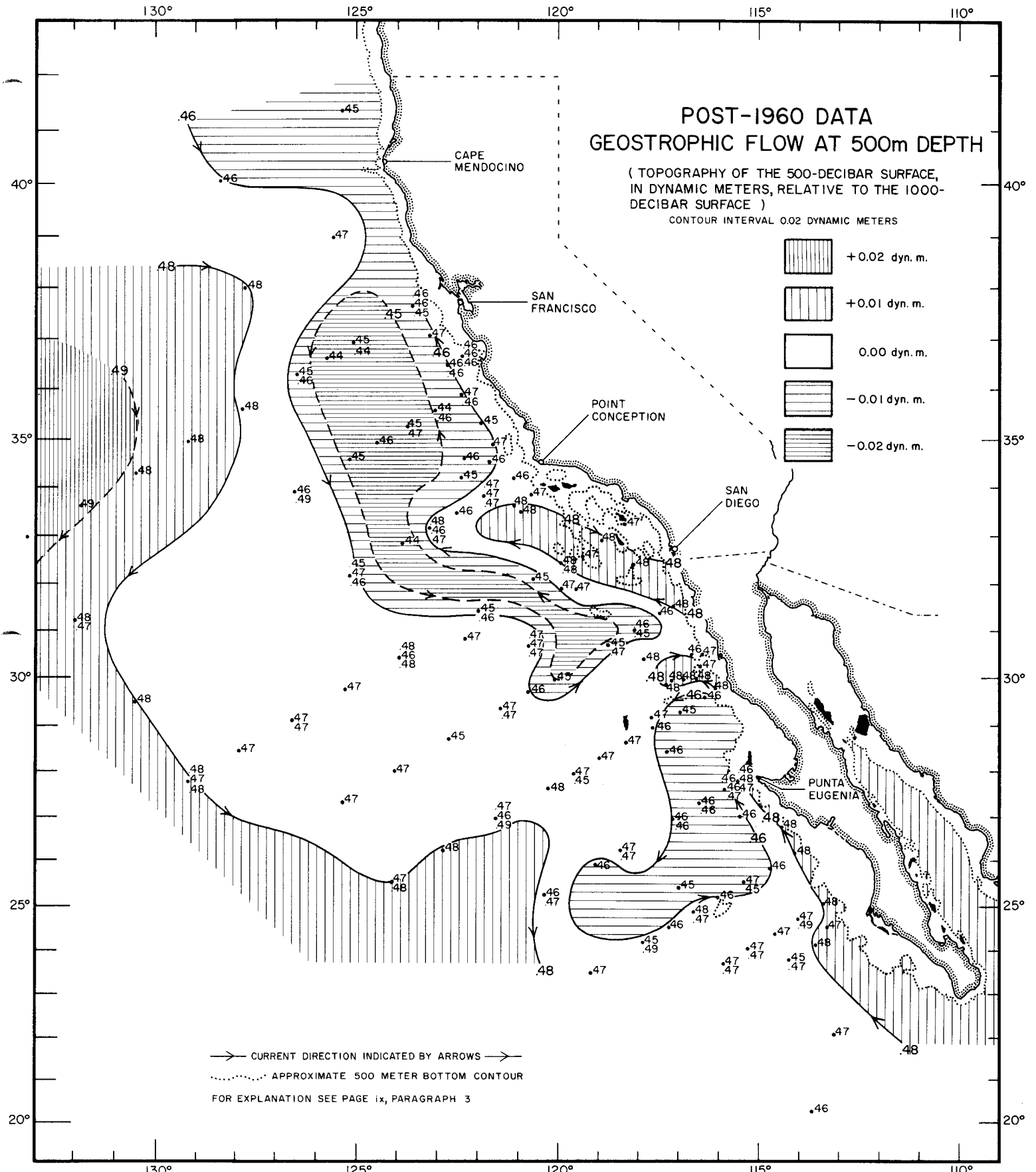


### POST-1960 DATA GEOSTROPHIC FLOW AT 1000m DEPTH

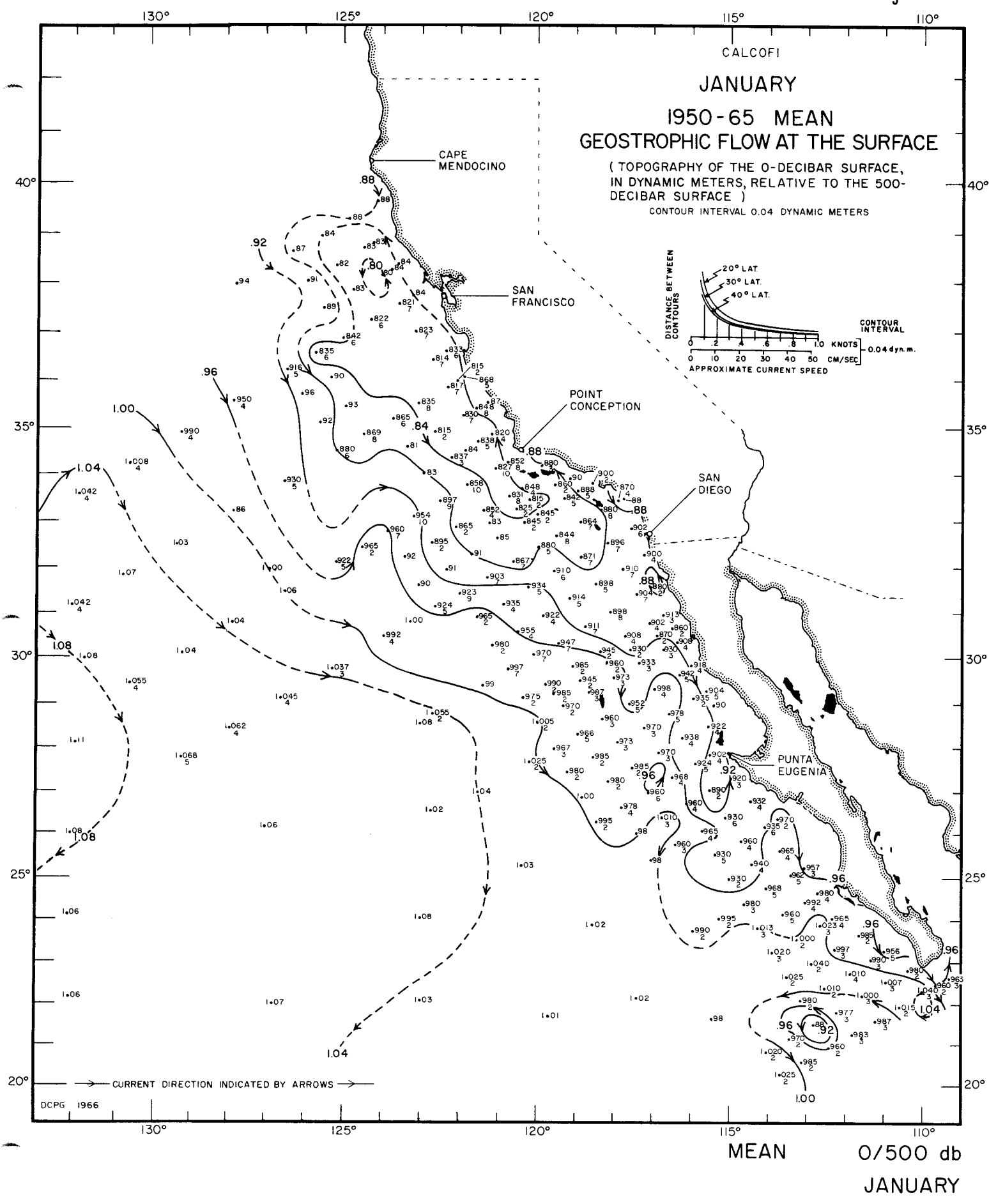
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IN DYNAMIC METERS, RELATIVE TO THE 2000-  
DECIBAR SURFACE )

APPROXIMATE 1000 METER BOTTOM CONTOUR

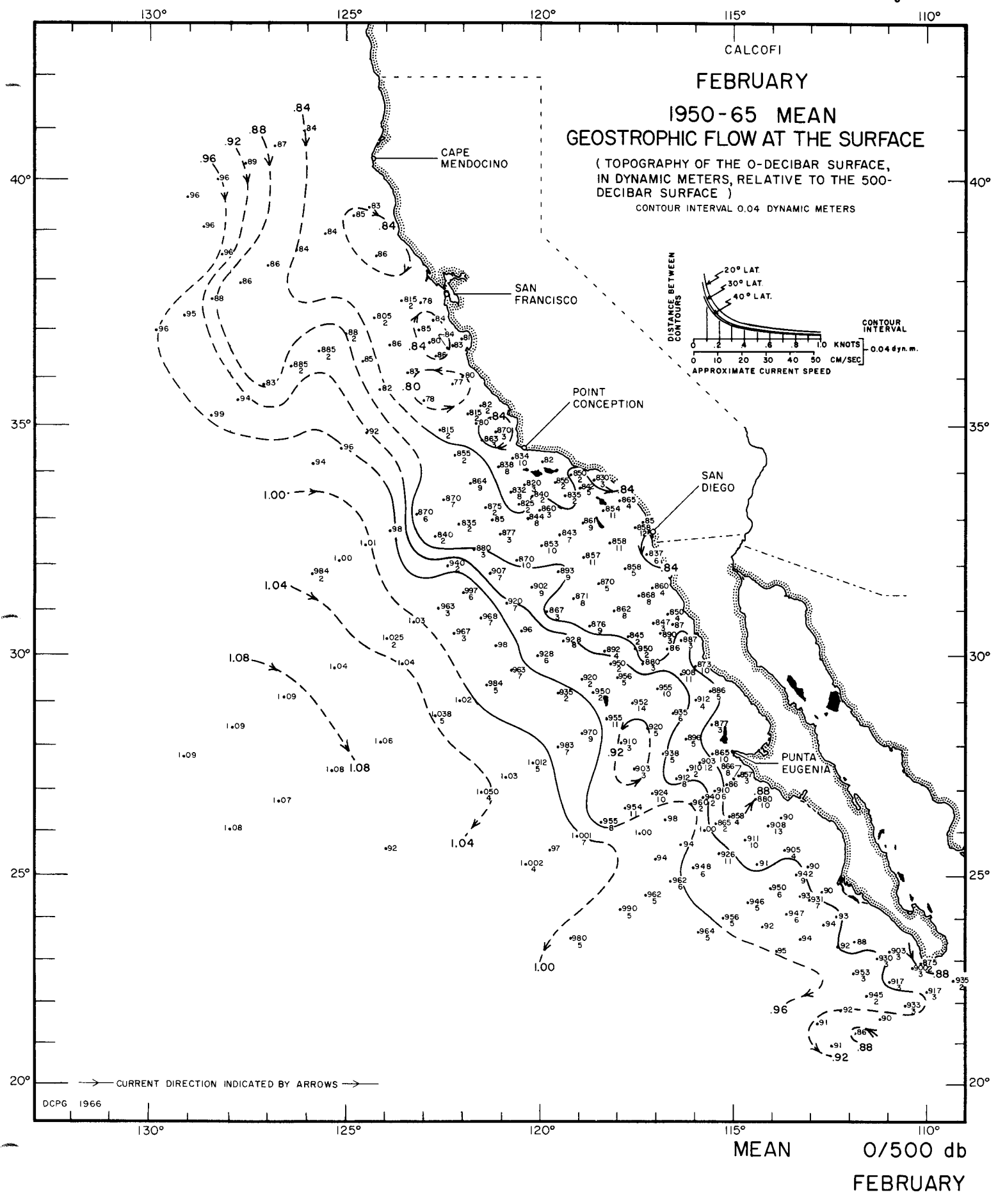
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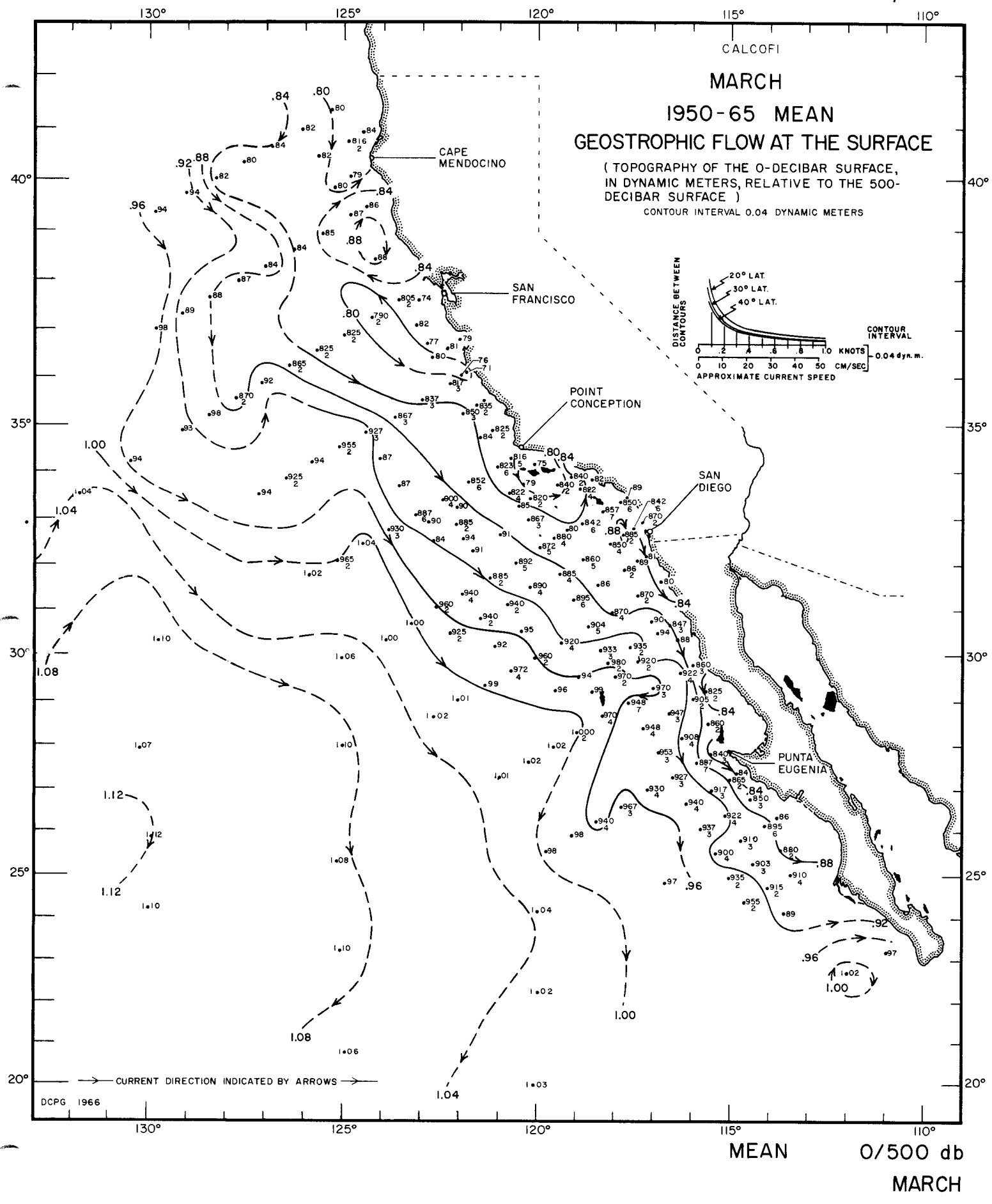


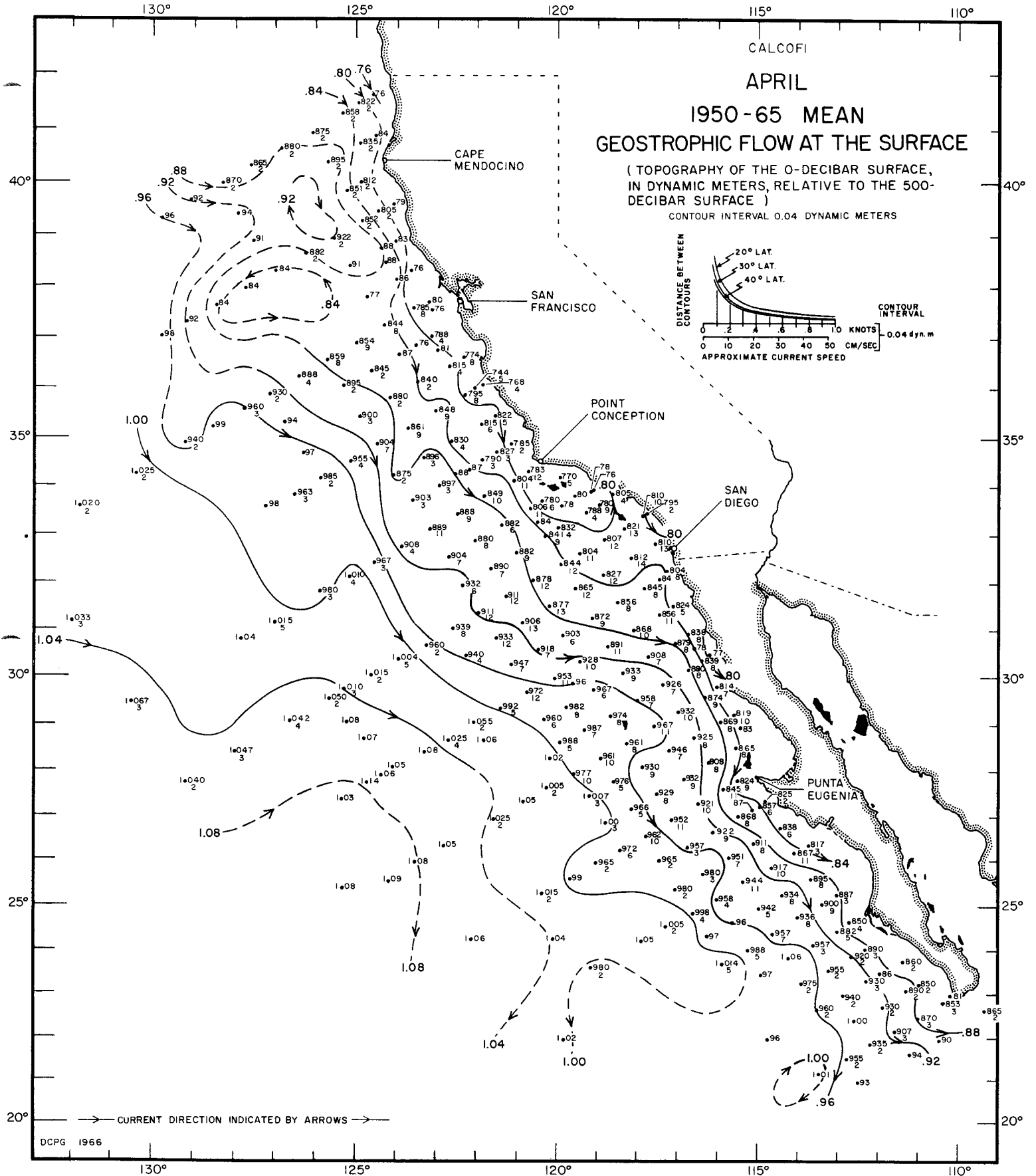
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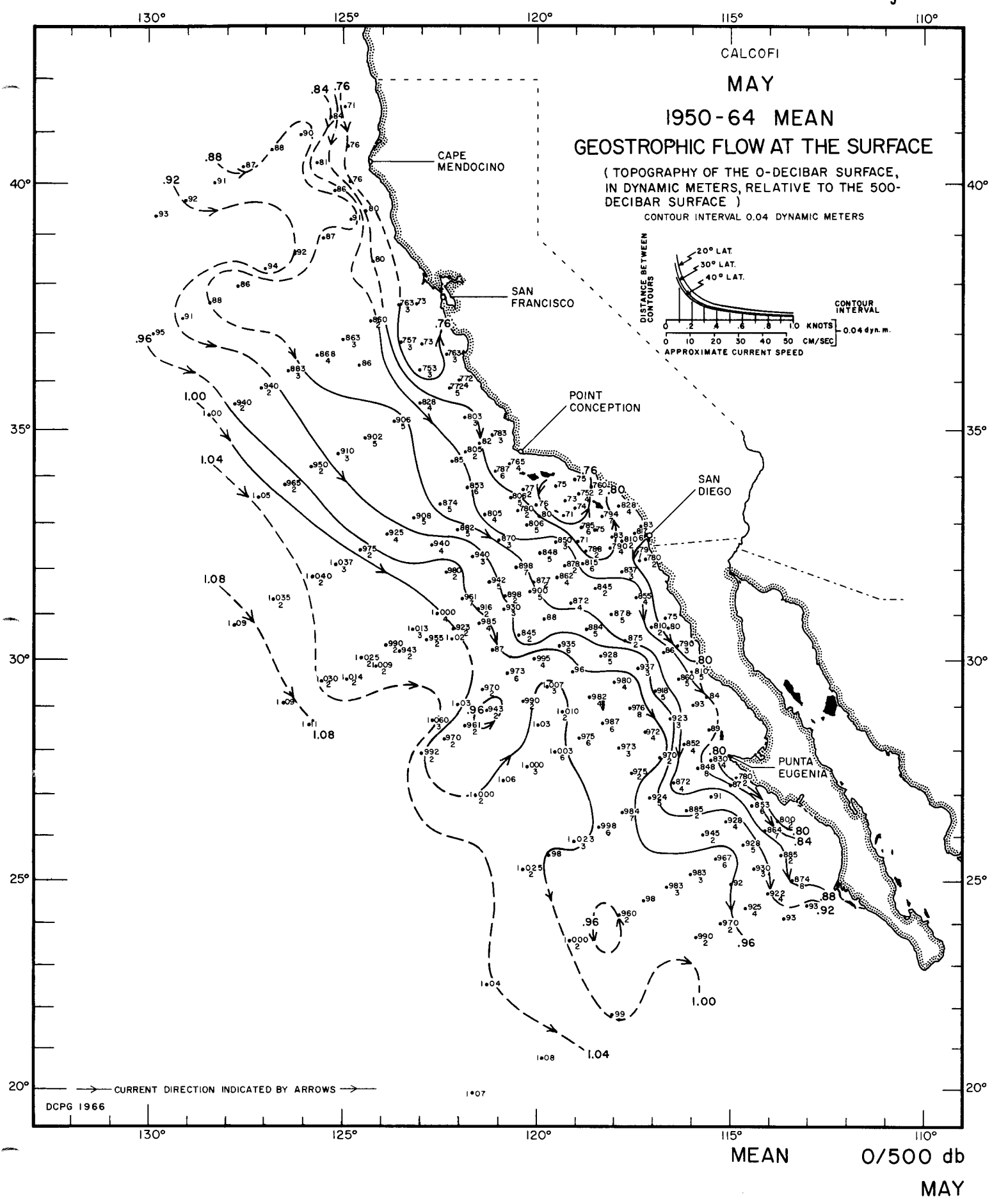


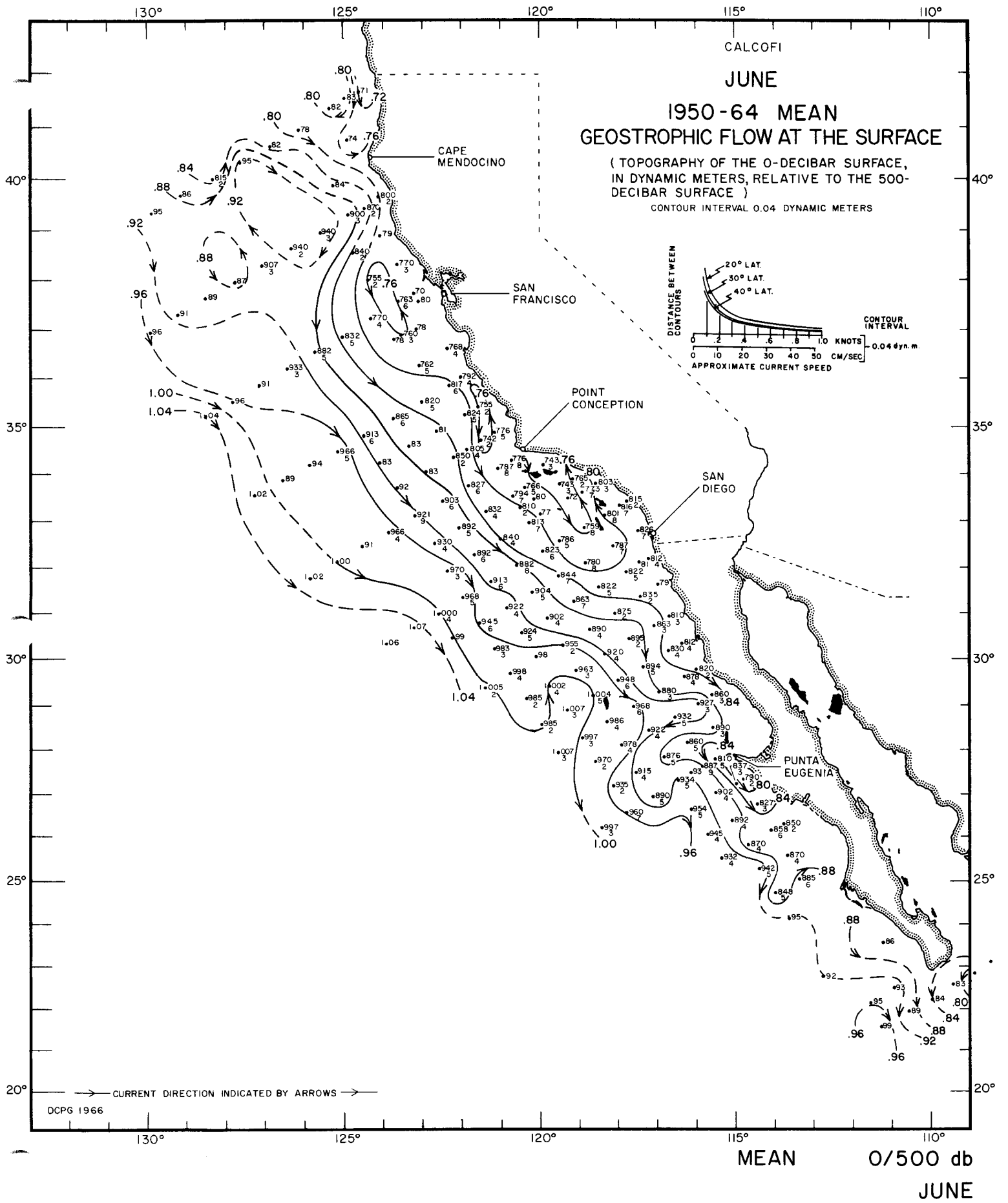


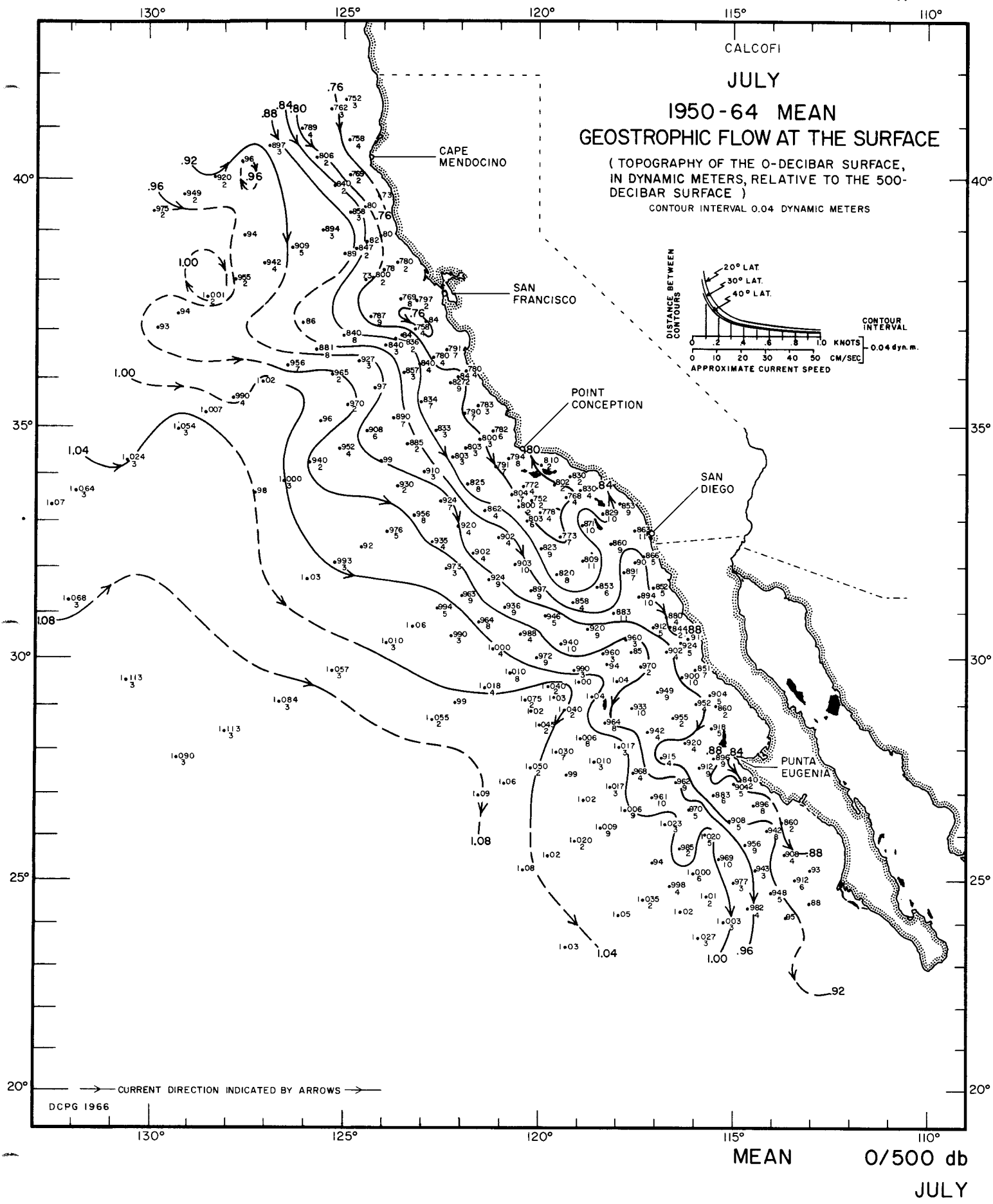


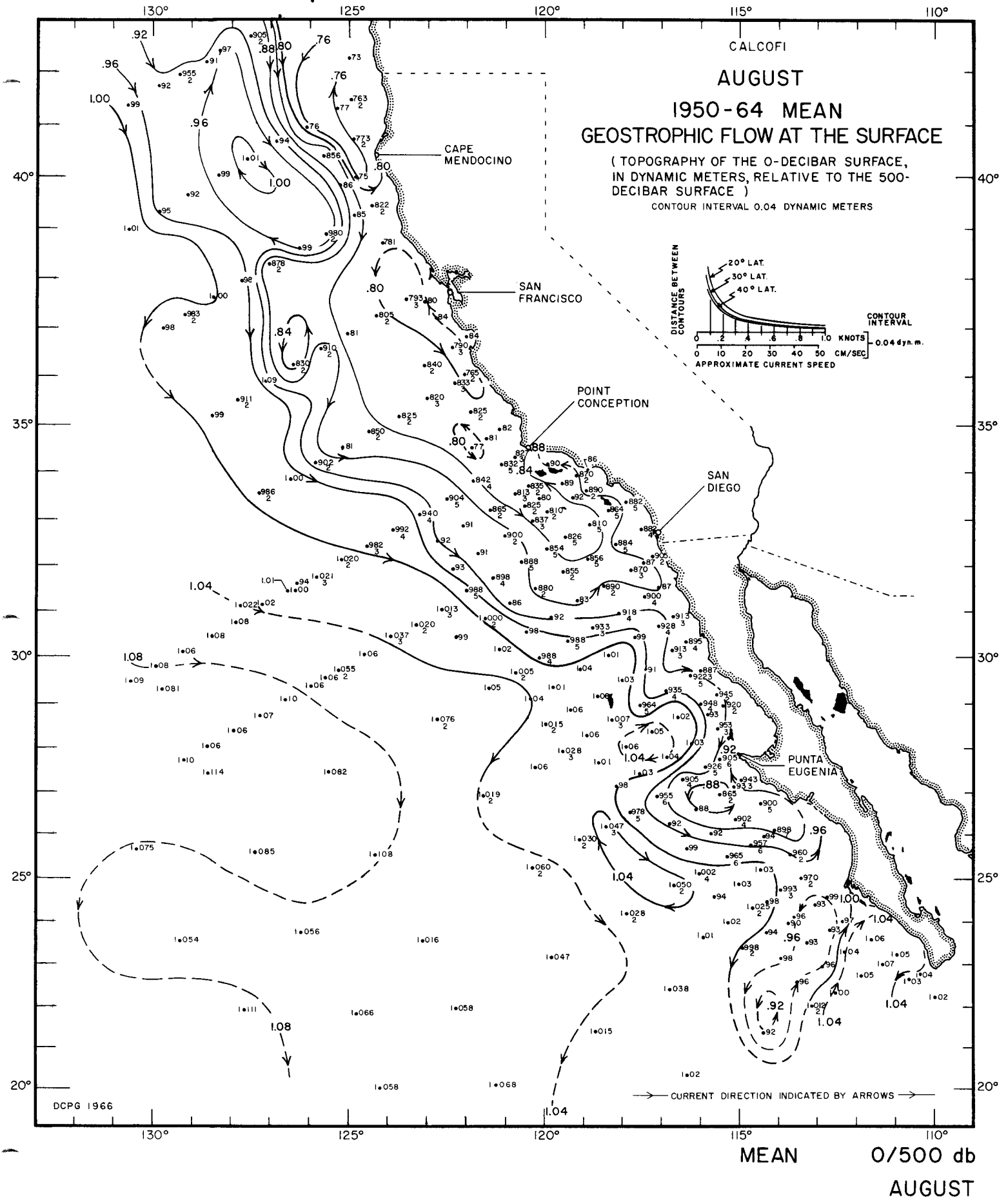


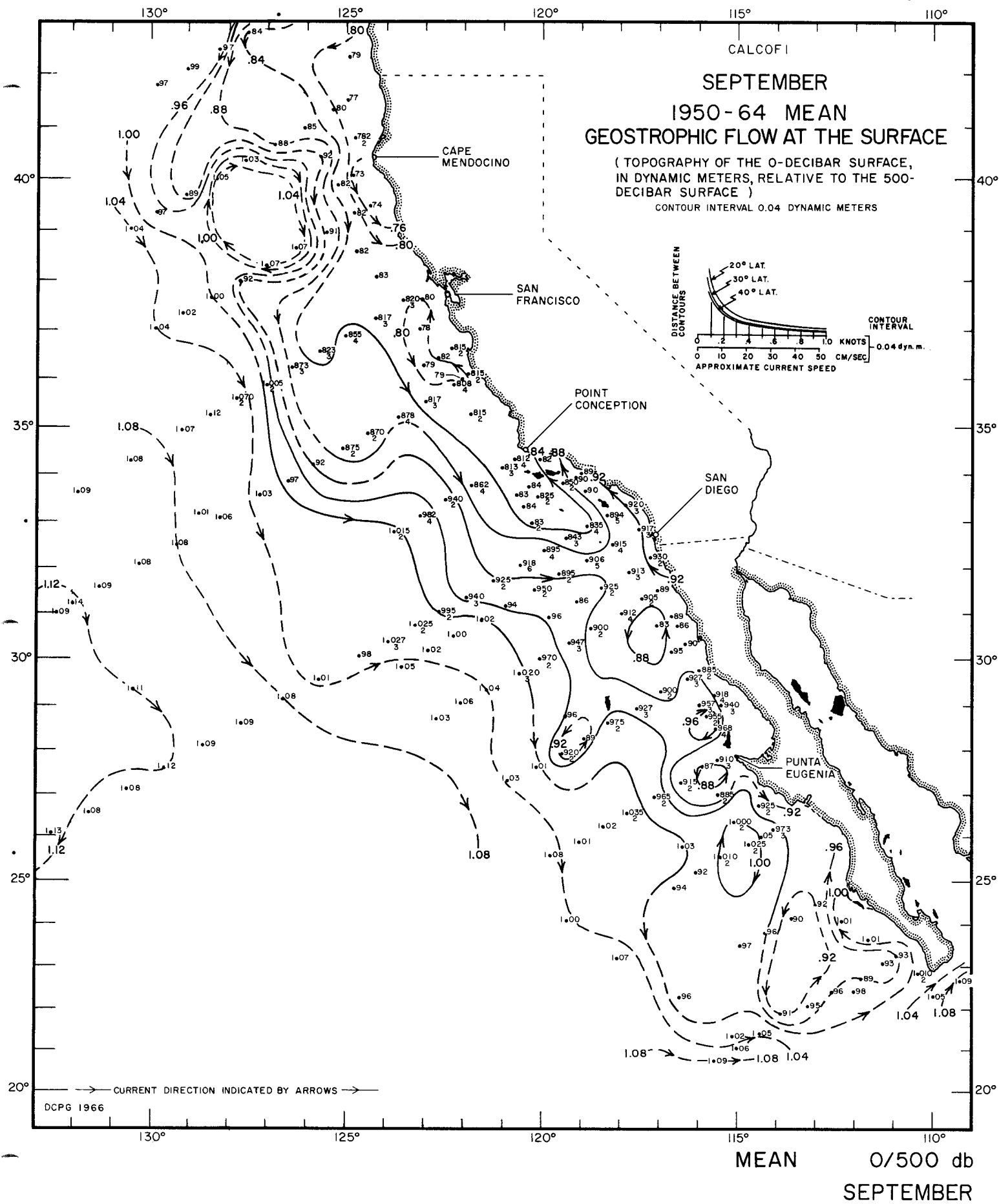
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APRIL



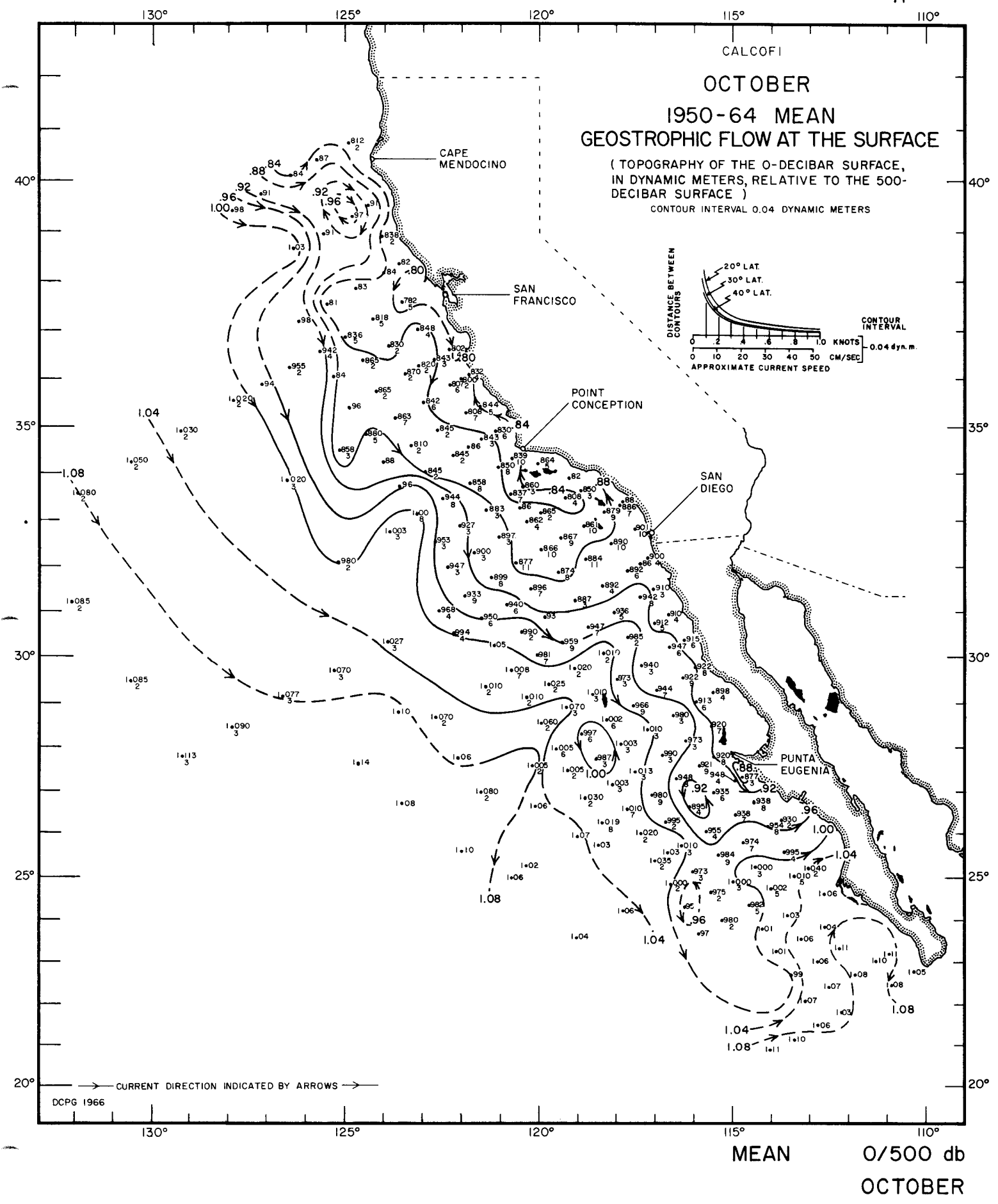












130° 125° 120° 115° 110°

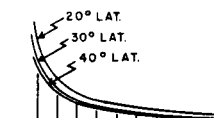
CALCOFI

# NOVEMBER 1950-64 MEAN GEOSTROPHIC FLOW AT THE SURFACE

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DECIBAR SURFACE )

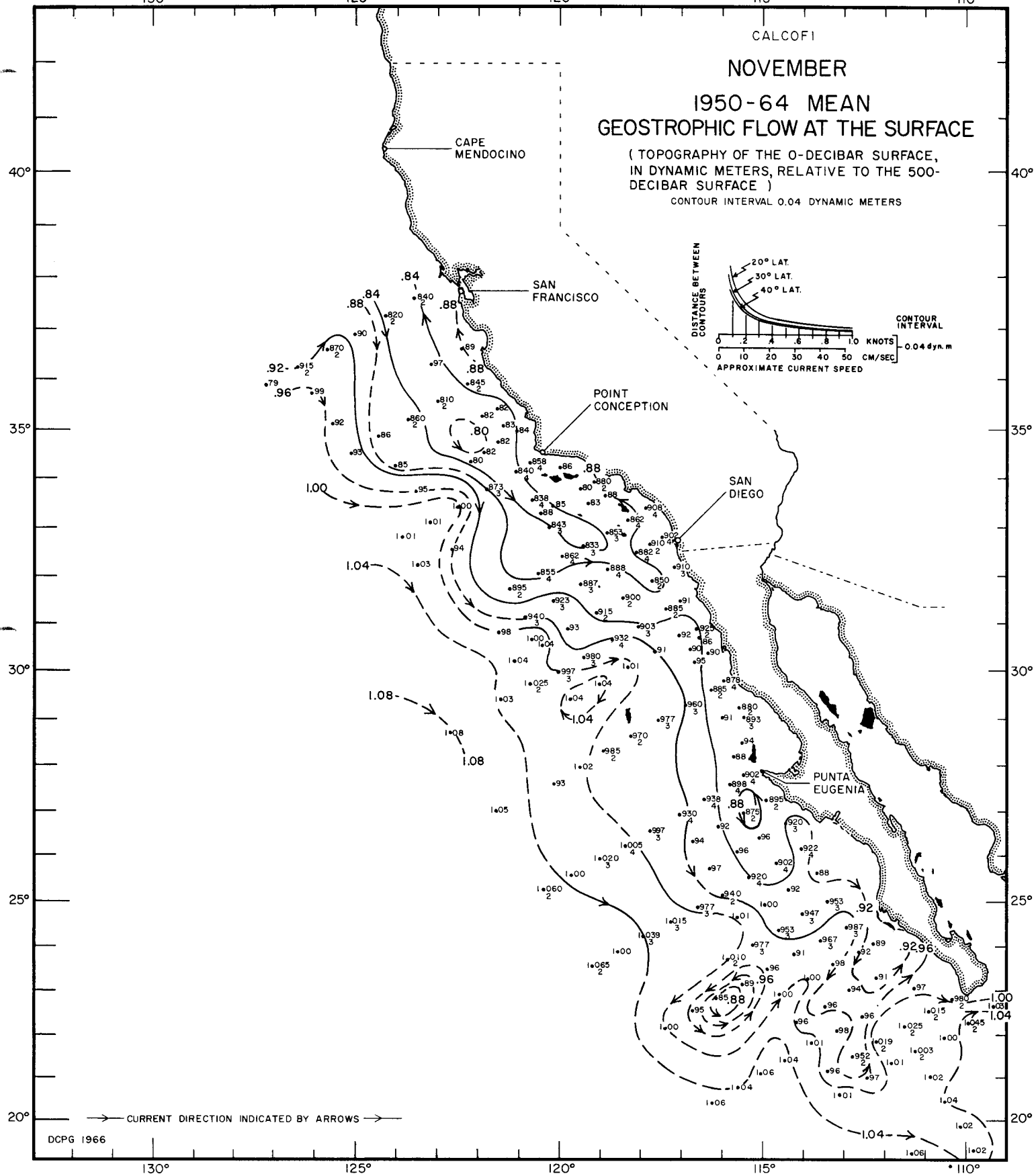
CONTOUR INTERVAL 0.04 DYNAMIC METERS

DISTANCE BETWEEN  
CONTOURS



CONTOUR  
INTERVAL  
0.04 dyn. m

APPROXIMATE CURRENT SPEED



→ CURRENT DIRECTION INDICATED BY ARROWS →

DCPG 1966

130° 125° 120° 115° 110°

MEAN 0/500 db  
NOVEMBER

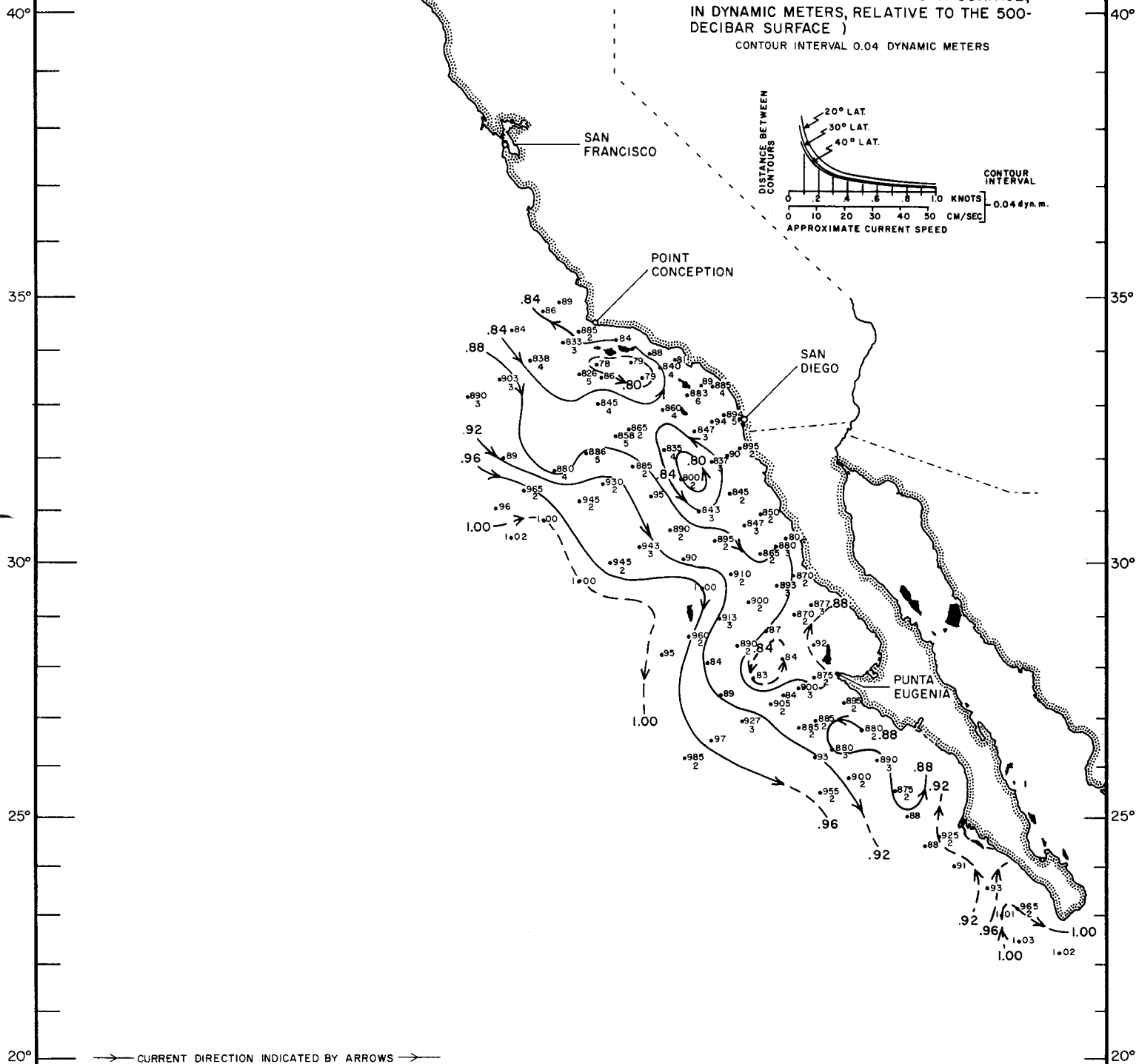
130° 125° 120° 115° 110°

CALCOFI

# DECEMBER 1950-64 MEAN GEOSTROPHIC FLOW AT THE SURFACE

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IN DYNAMIC METERS, RELATIVE TO THE 500-  
DECIBAR SURFACE )

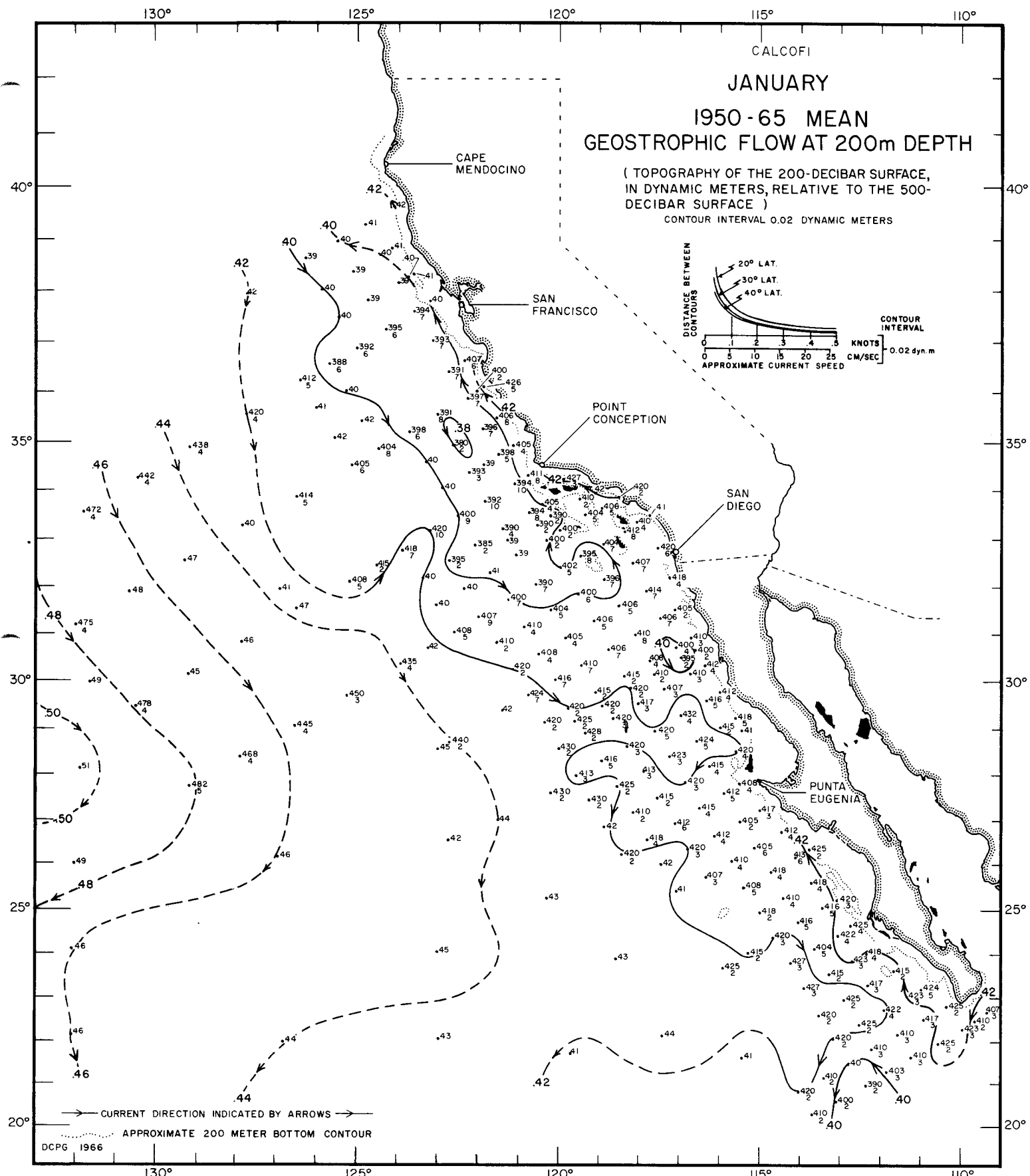
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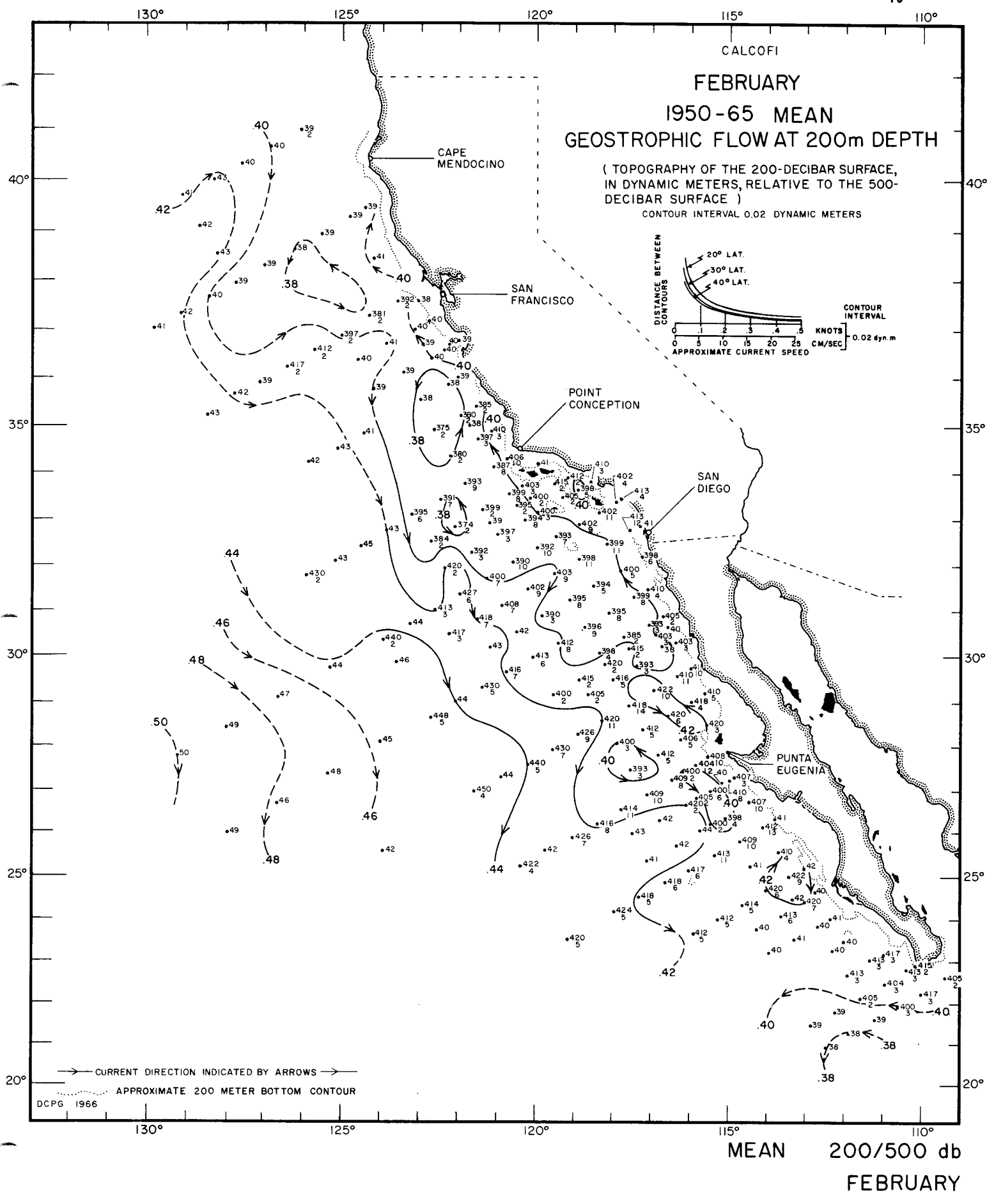
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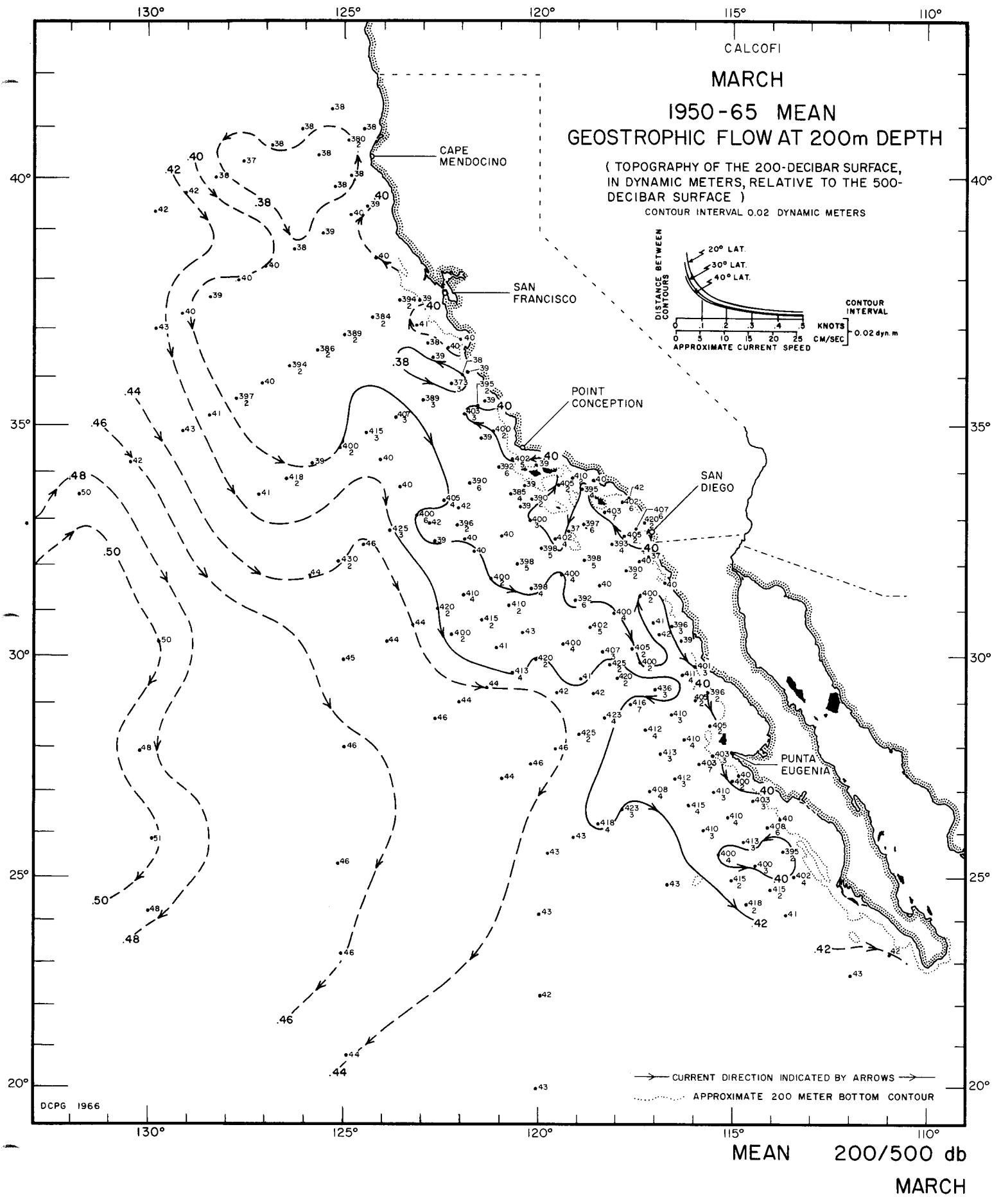
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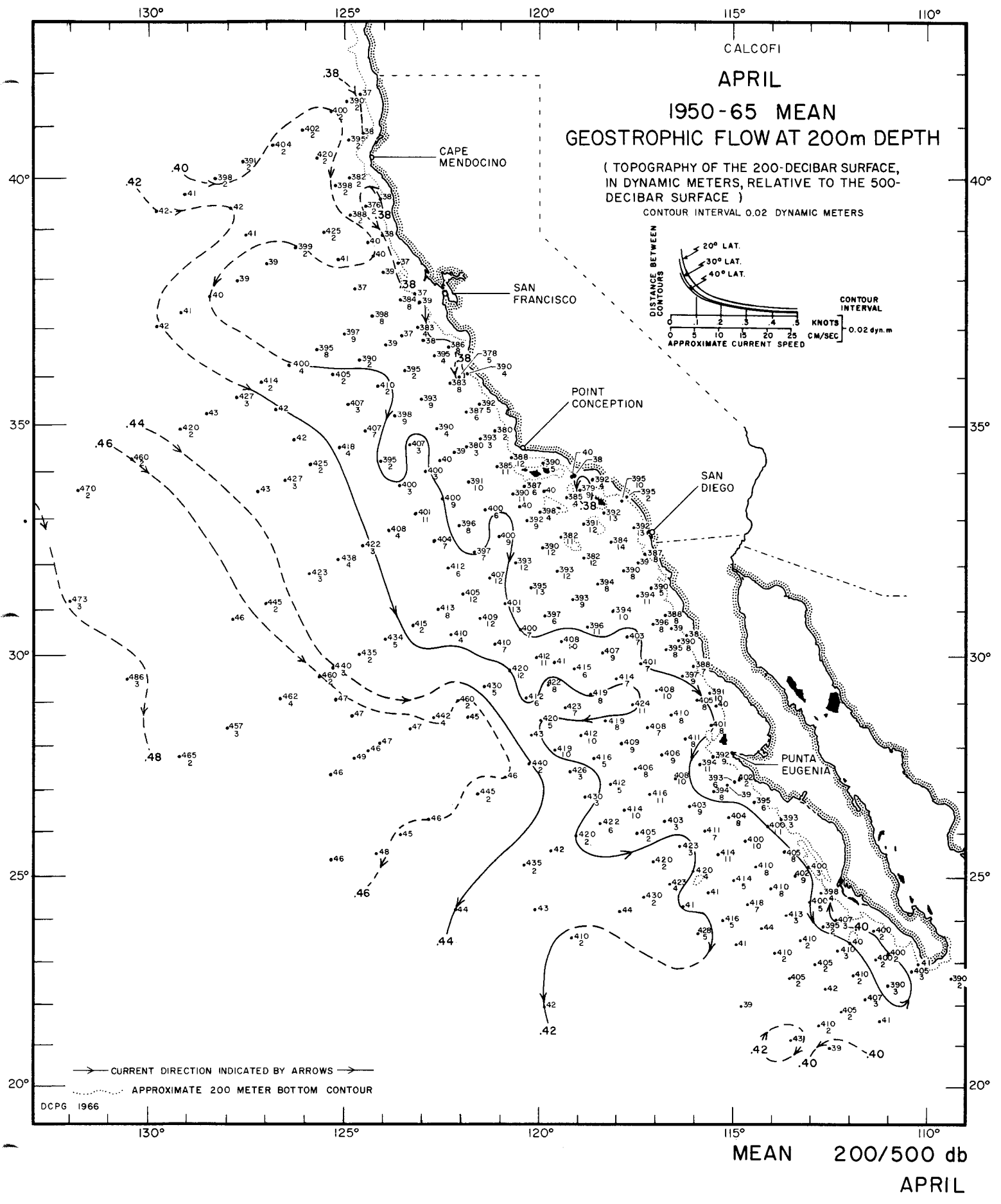
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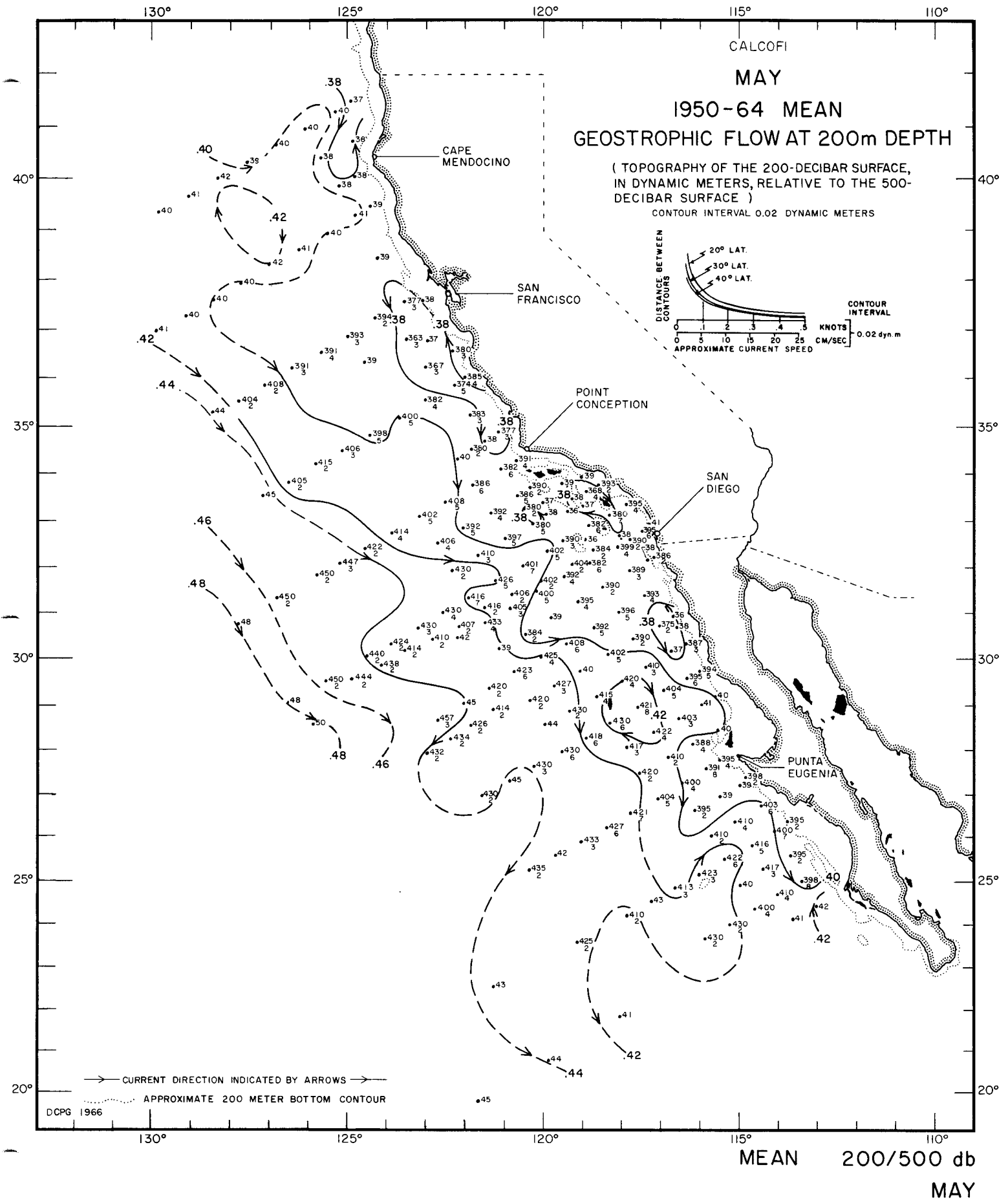


MEAN 200/500 db  
JANUARY

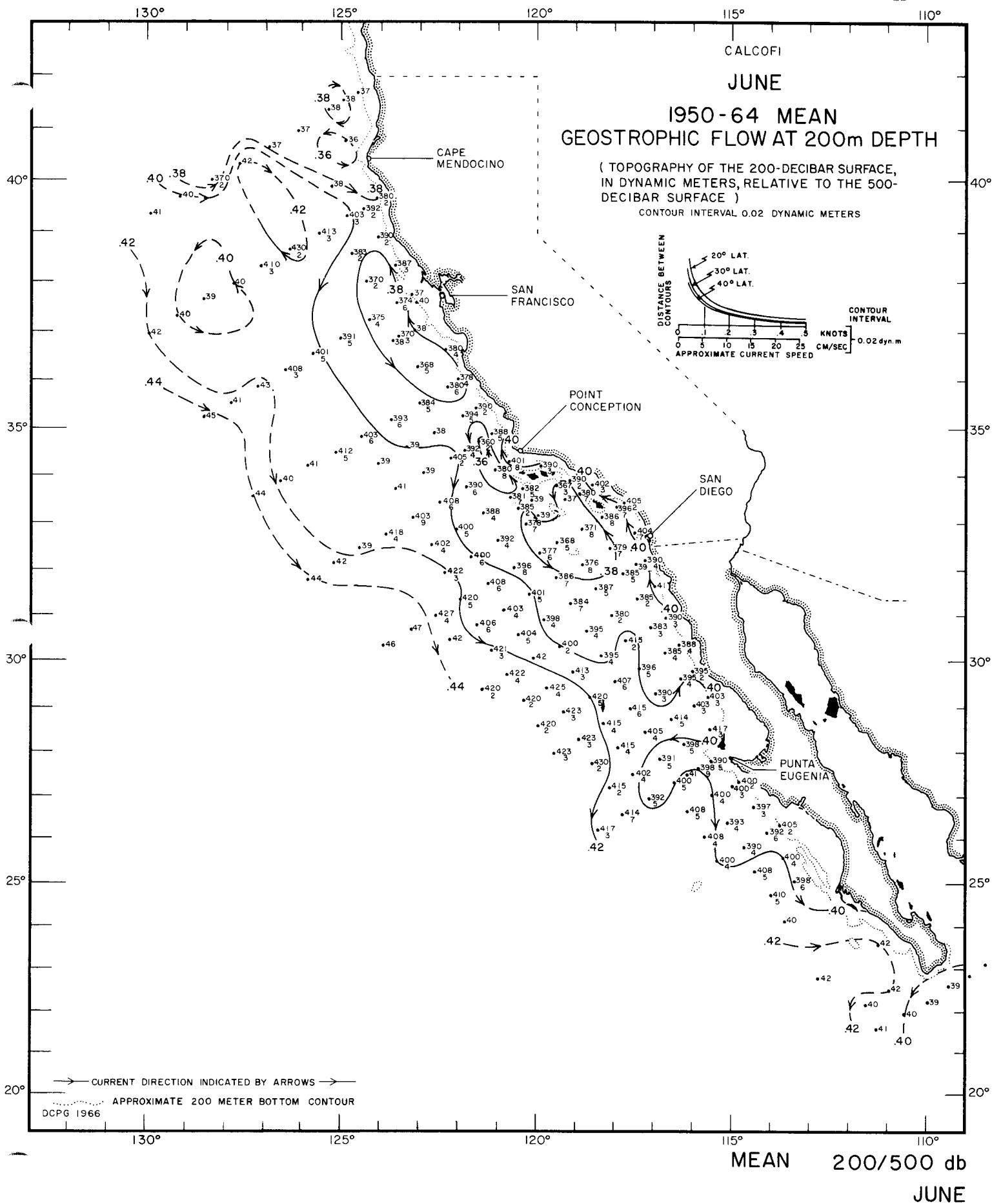


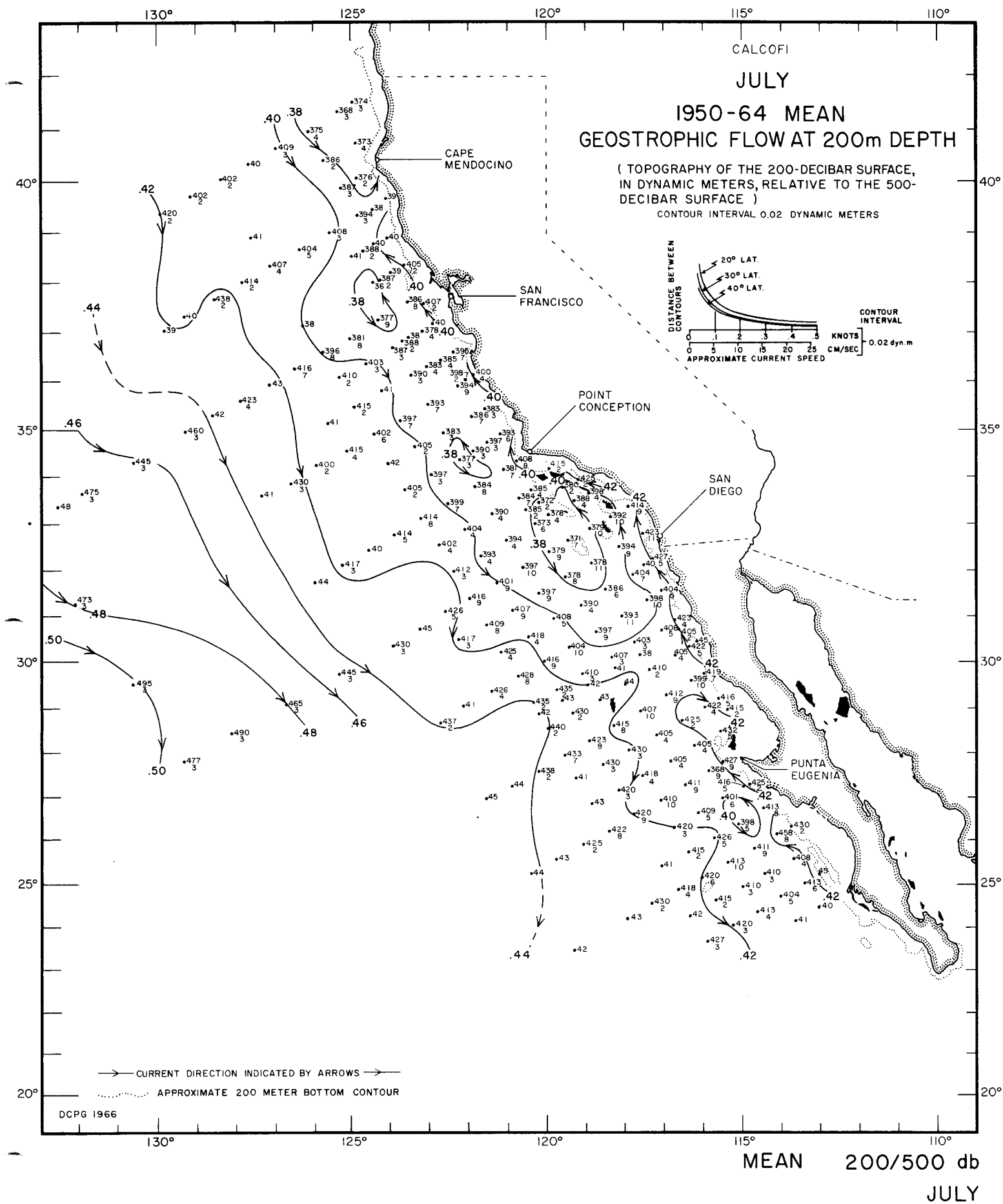


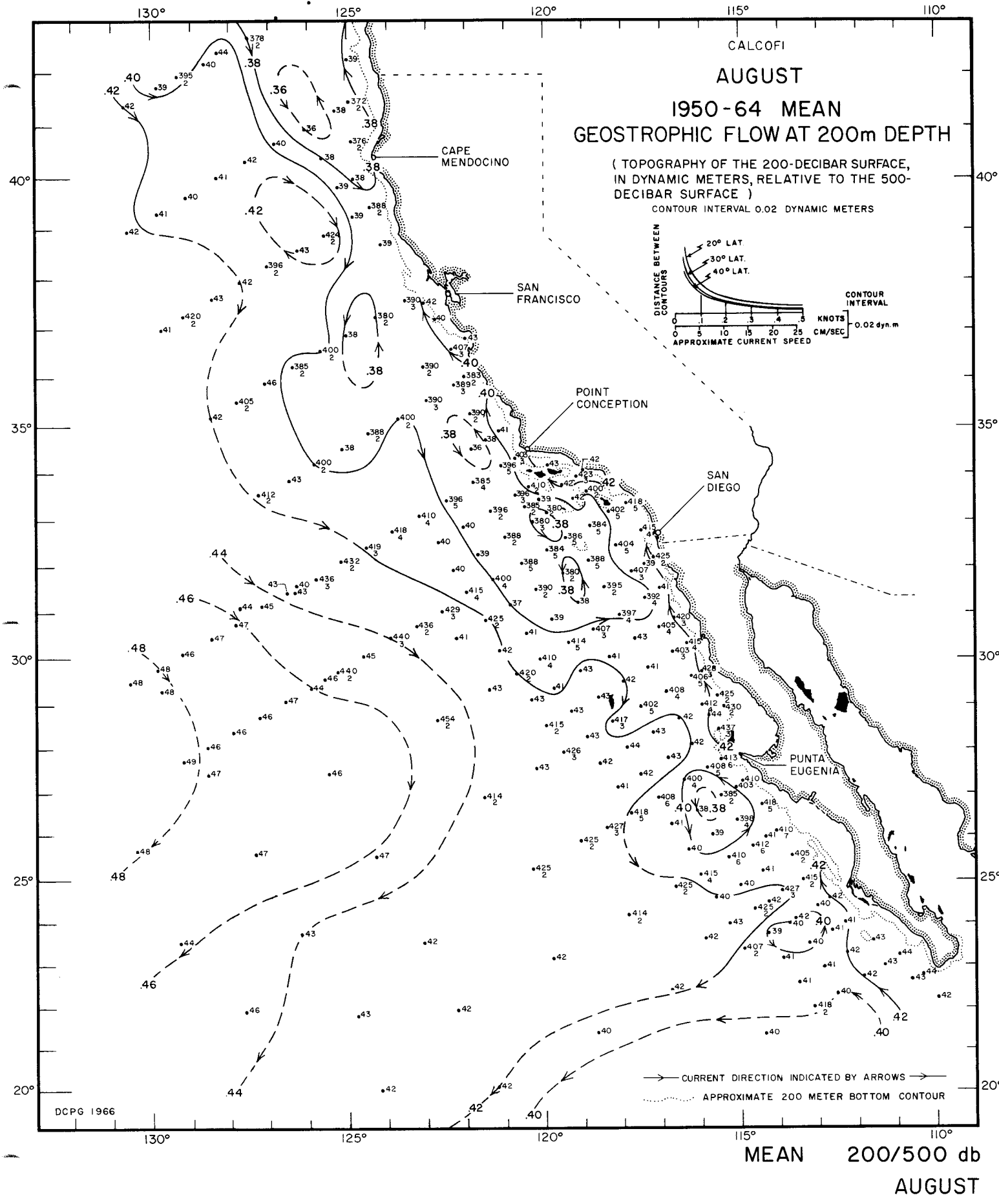


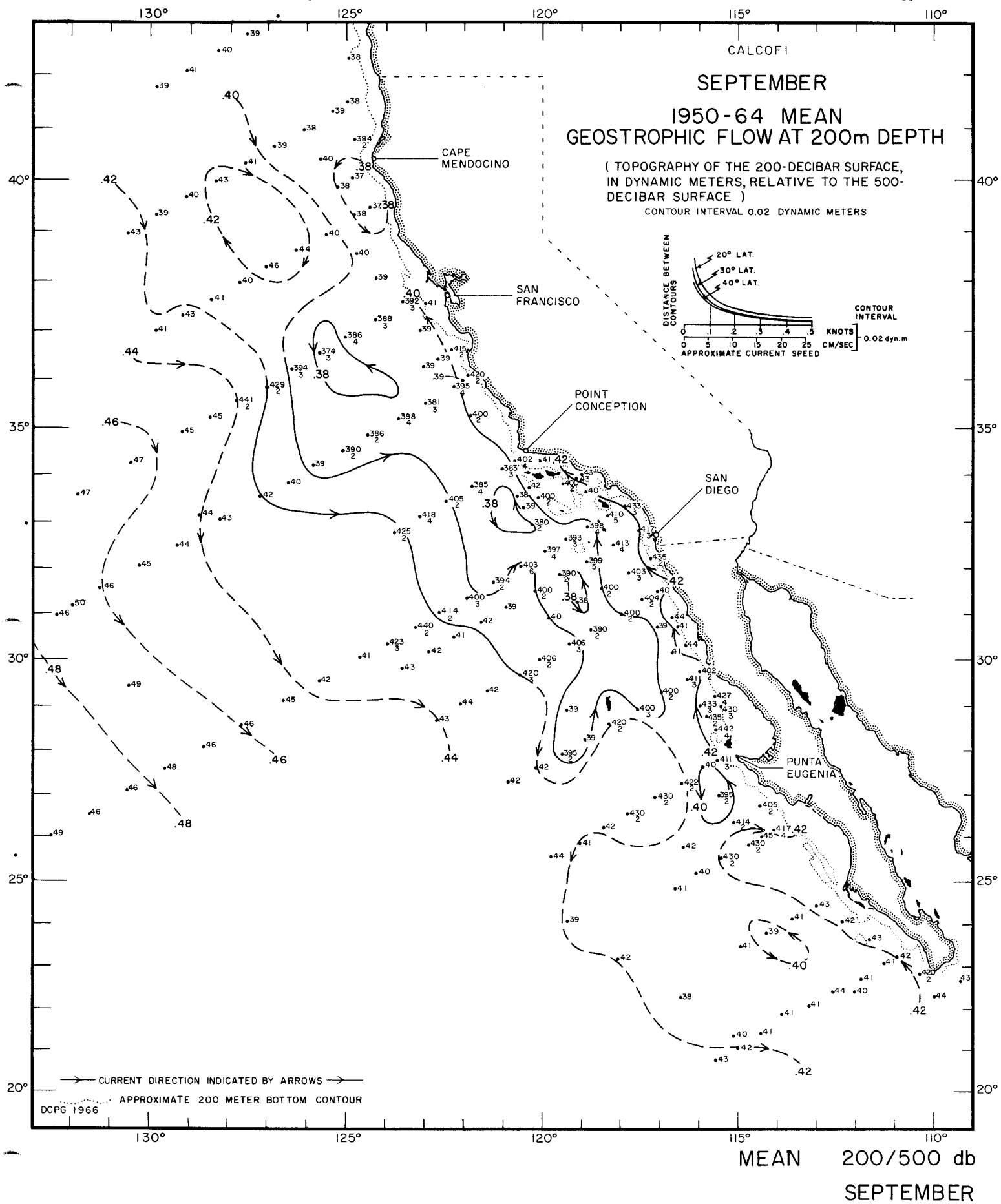


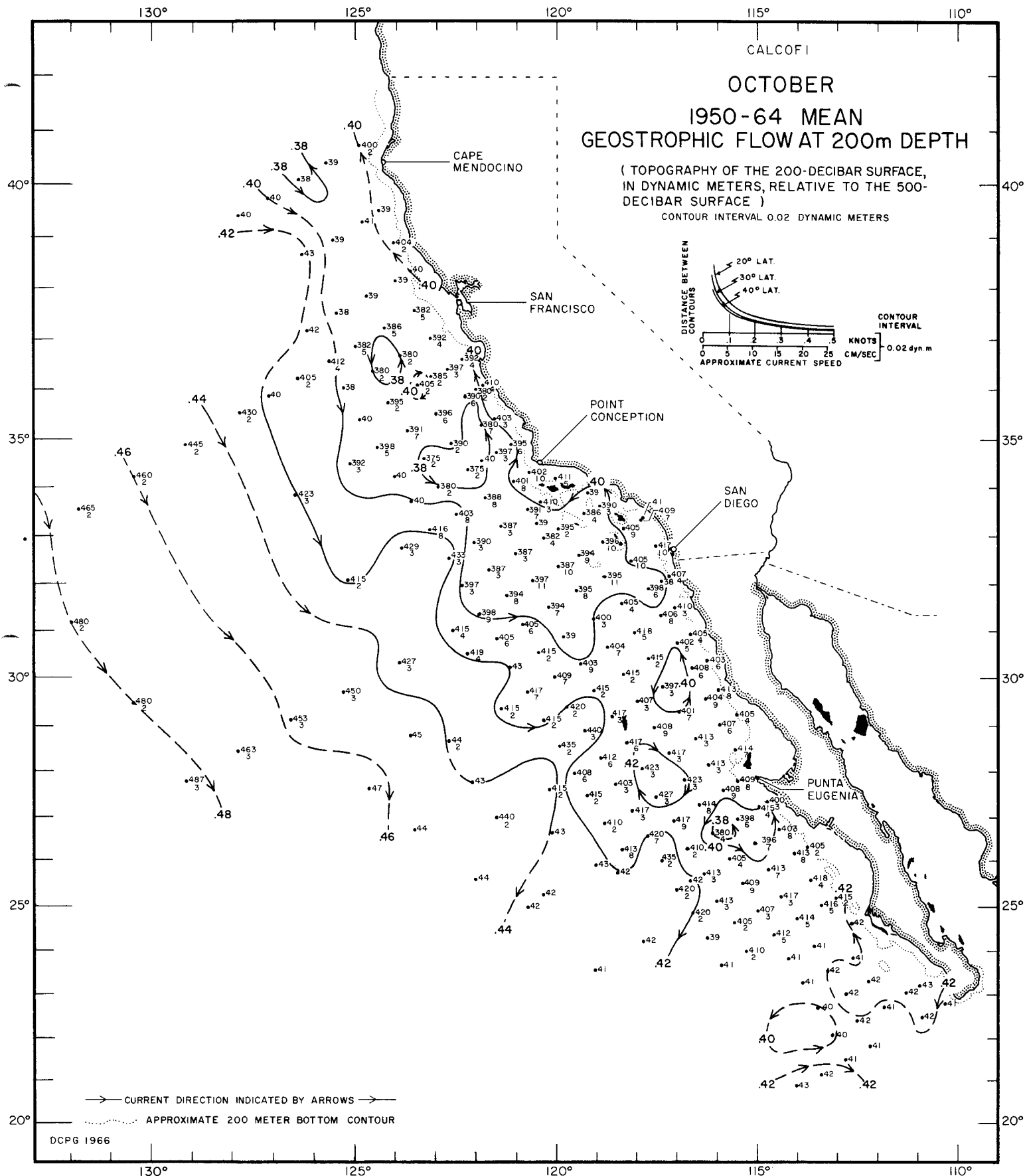






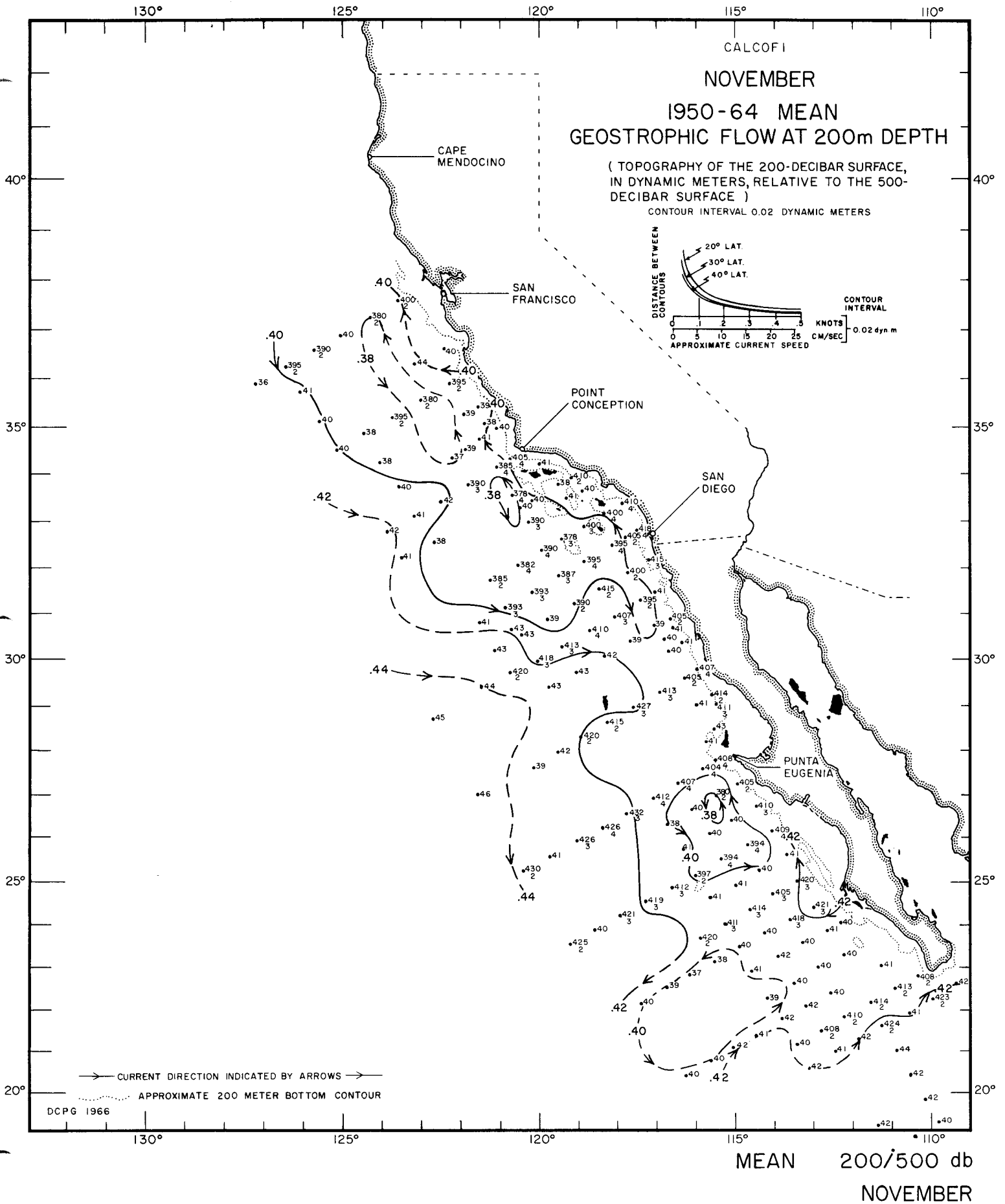


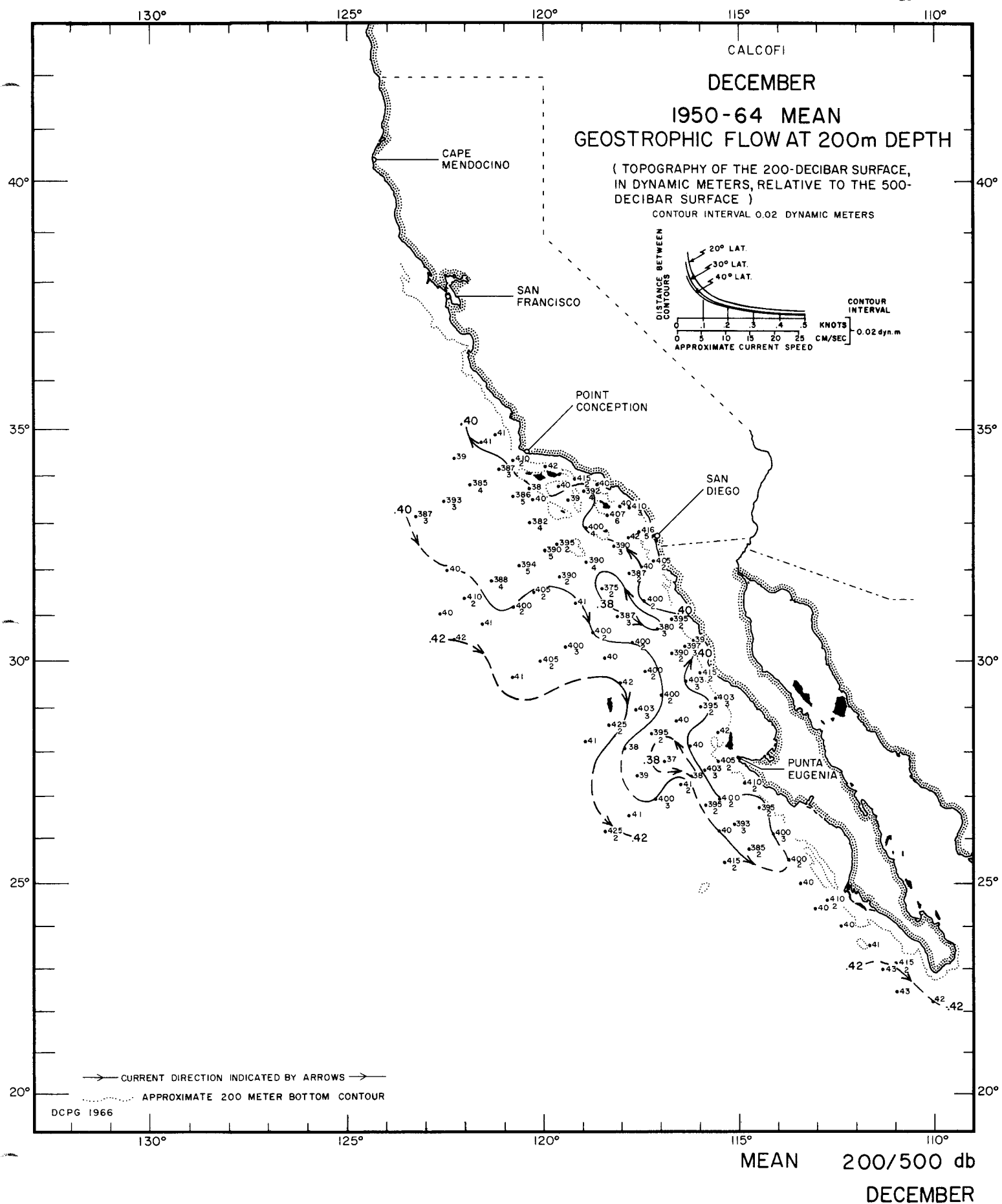


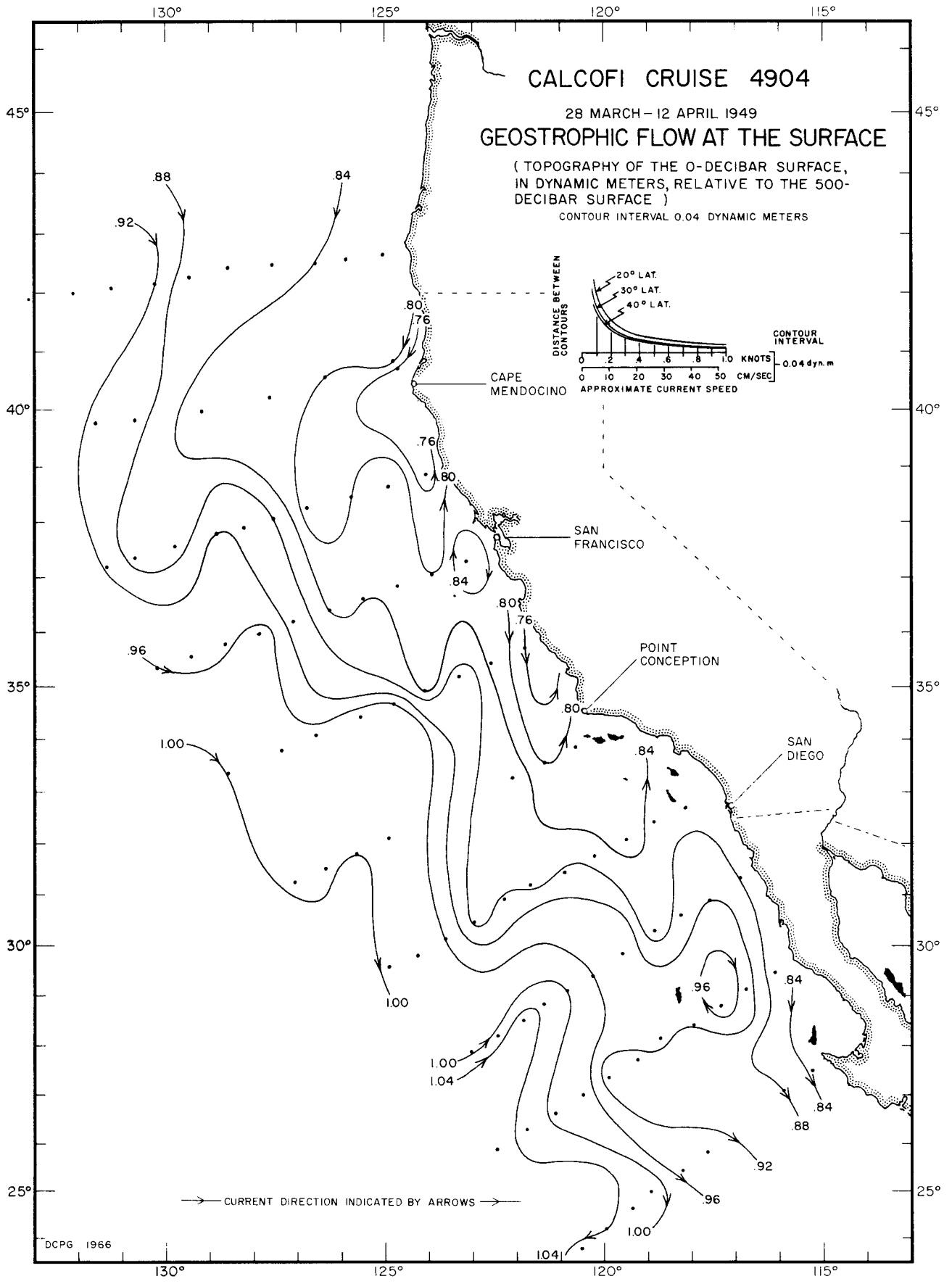


MEAN 200/500 db  
OCTOBER

DCPG 1966



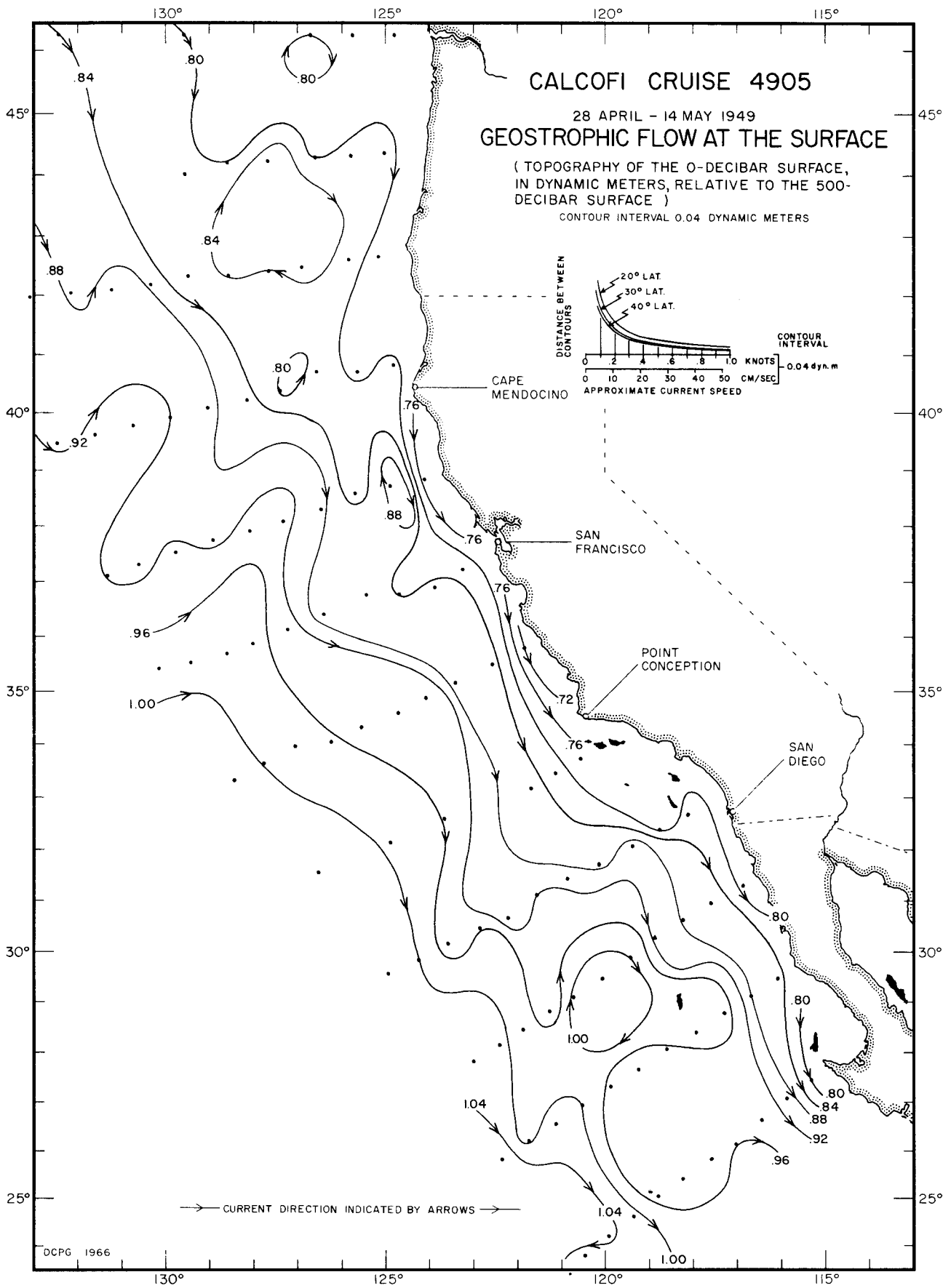




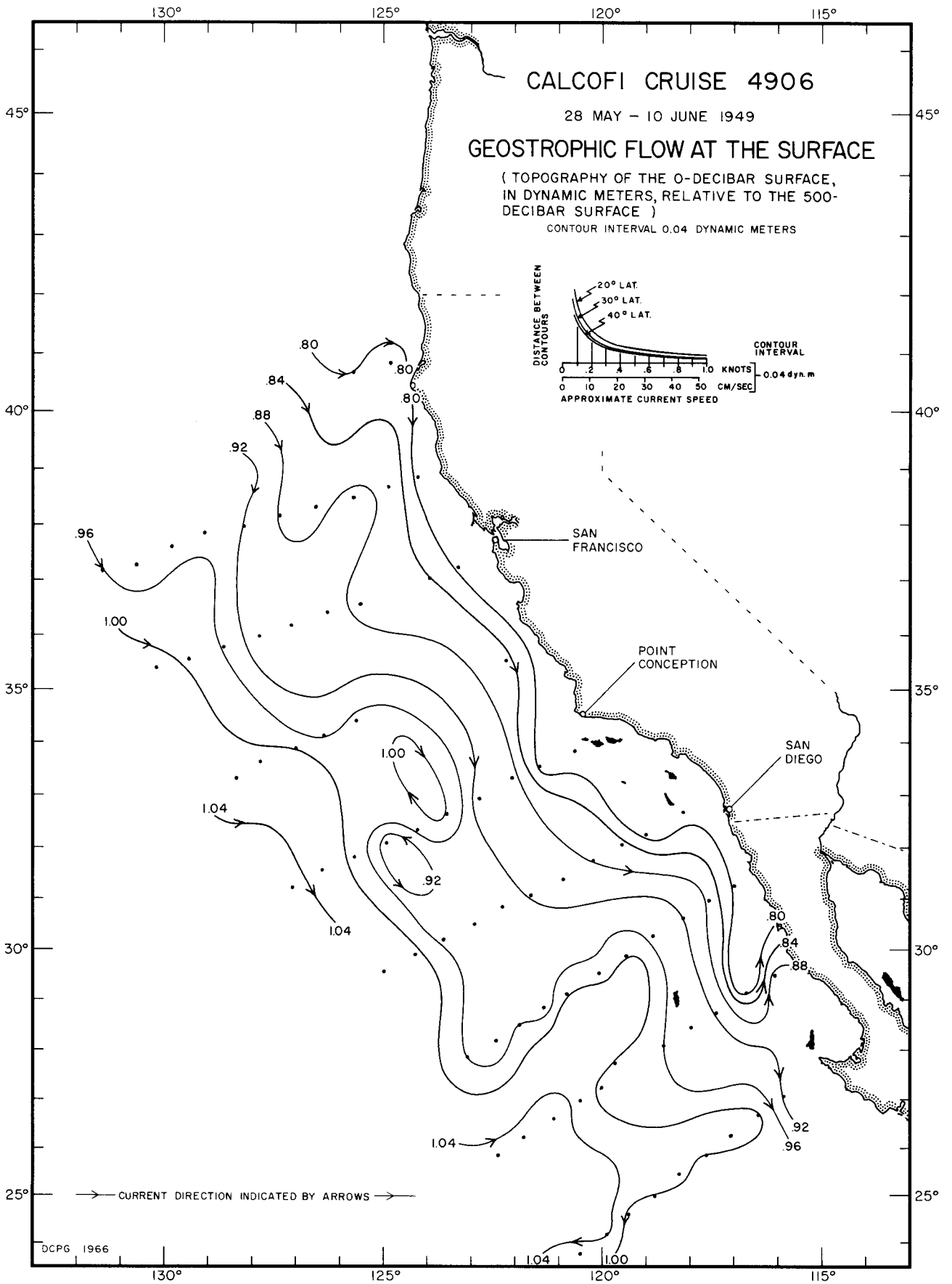
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O/500 db  
4904

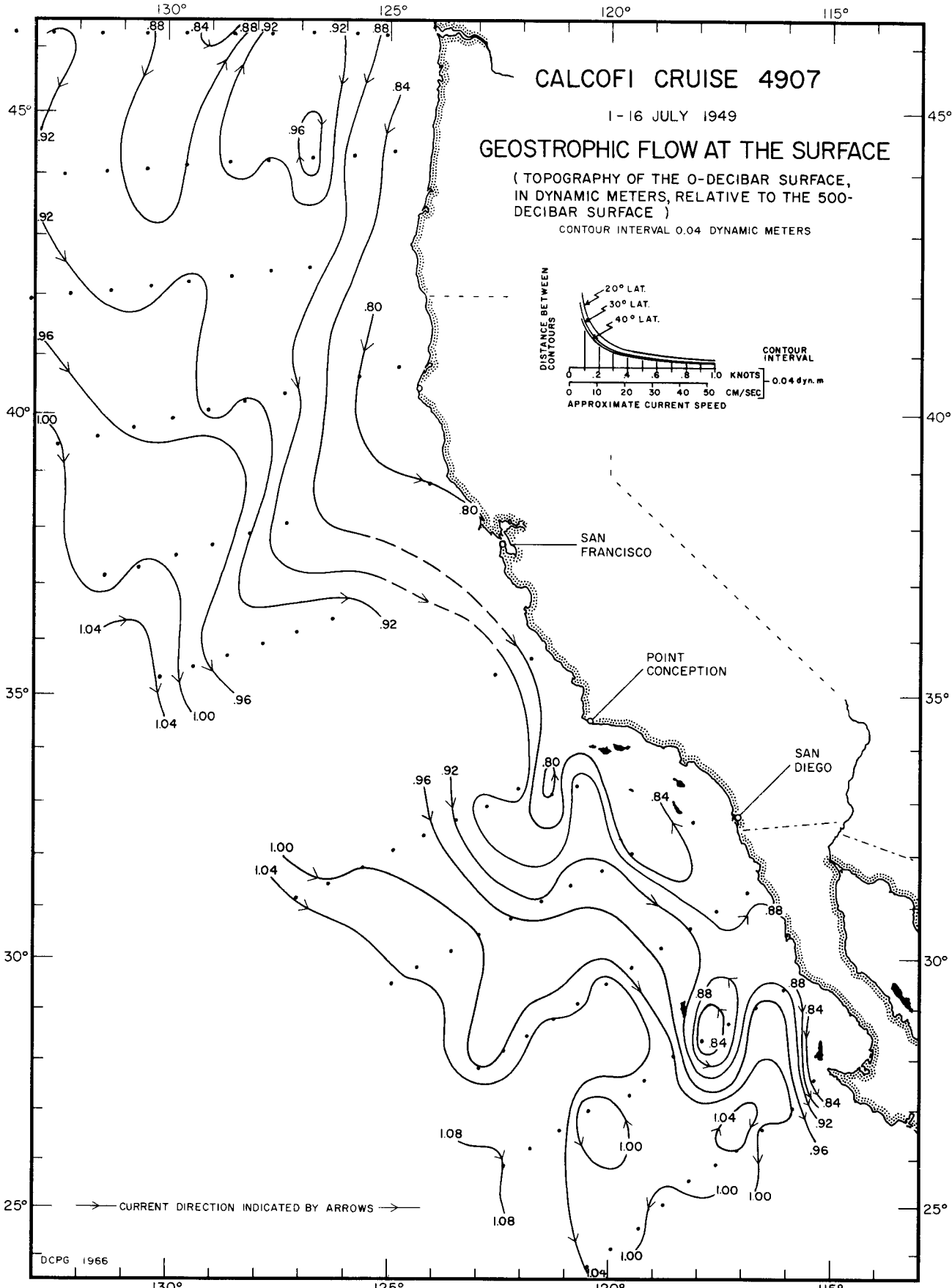




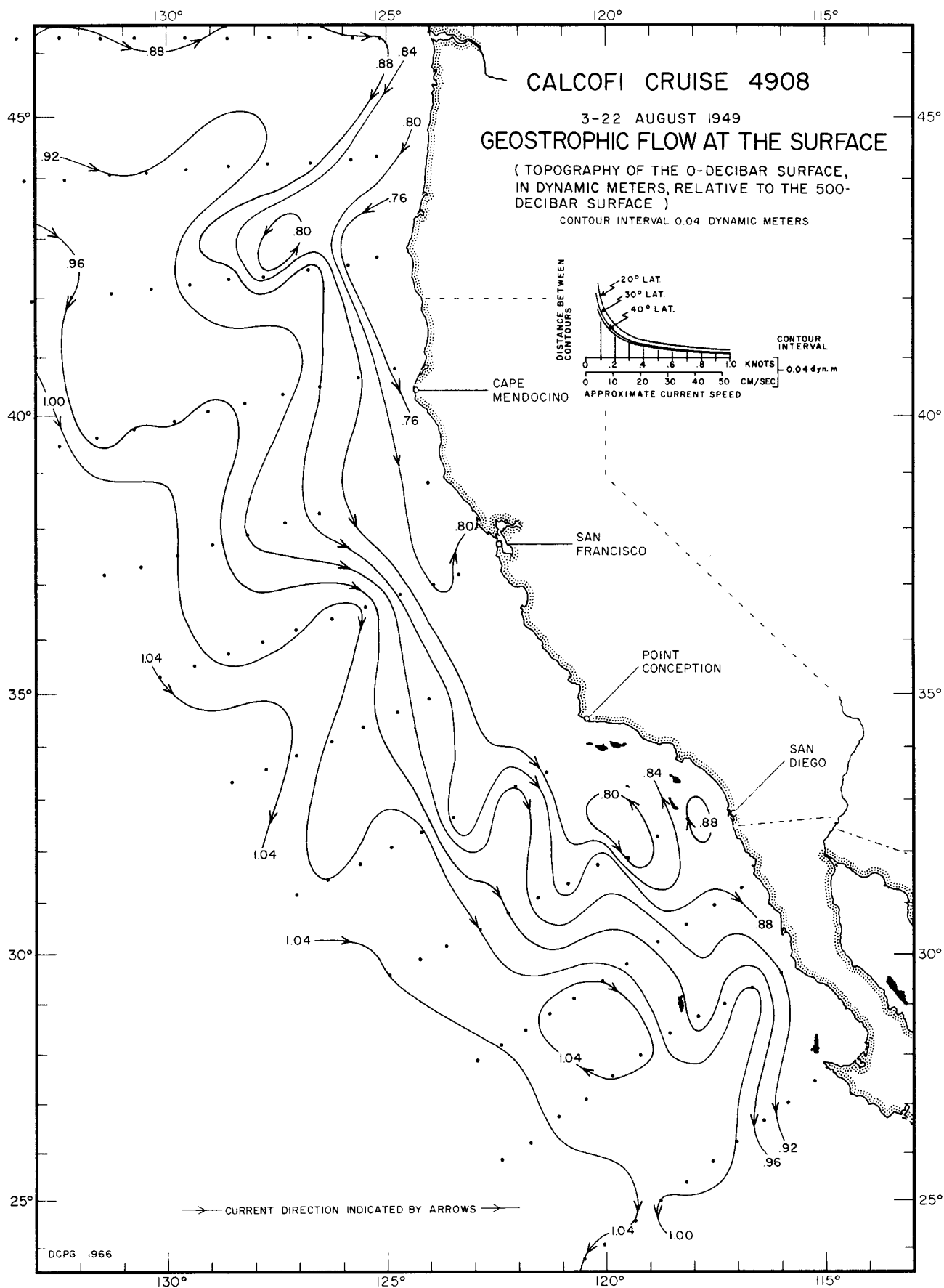
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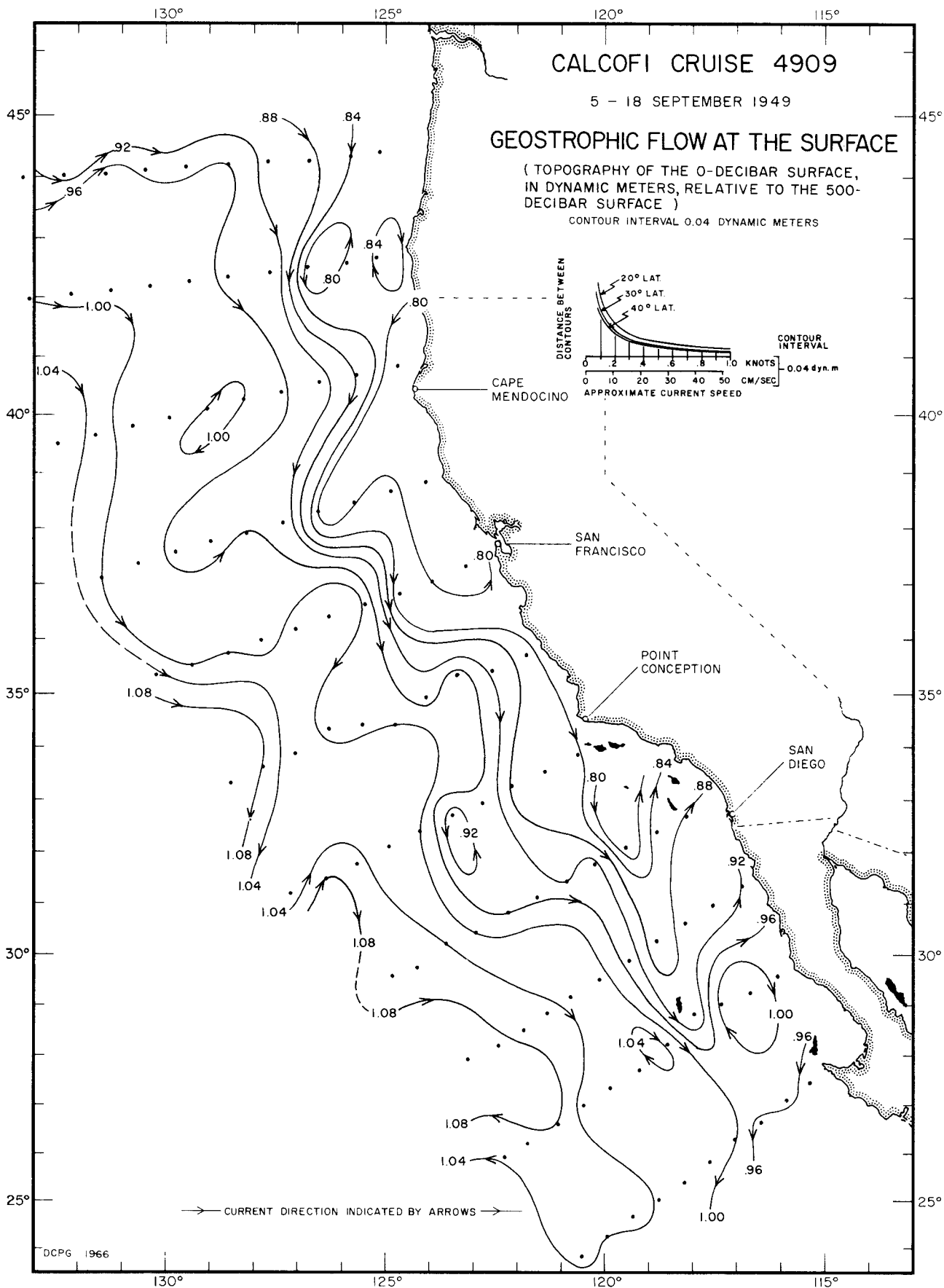
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4906



0/500 db  
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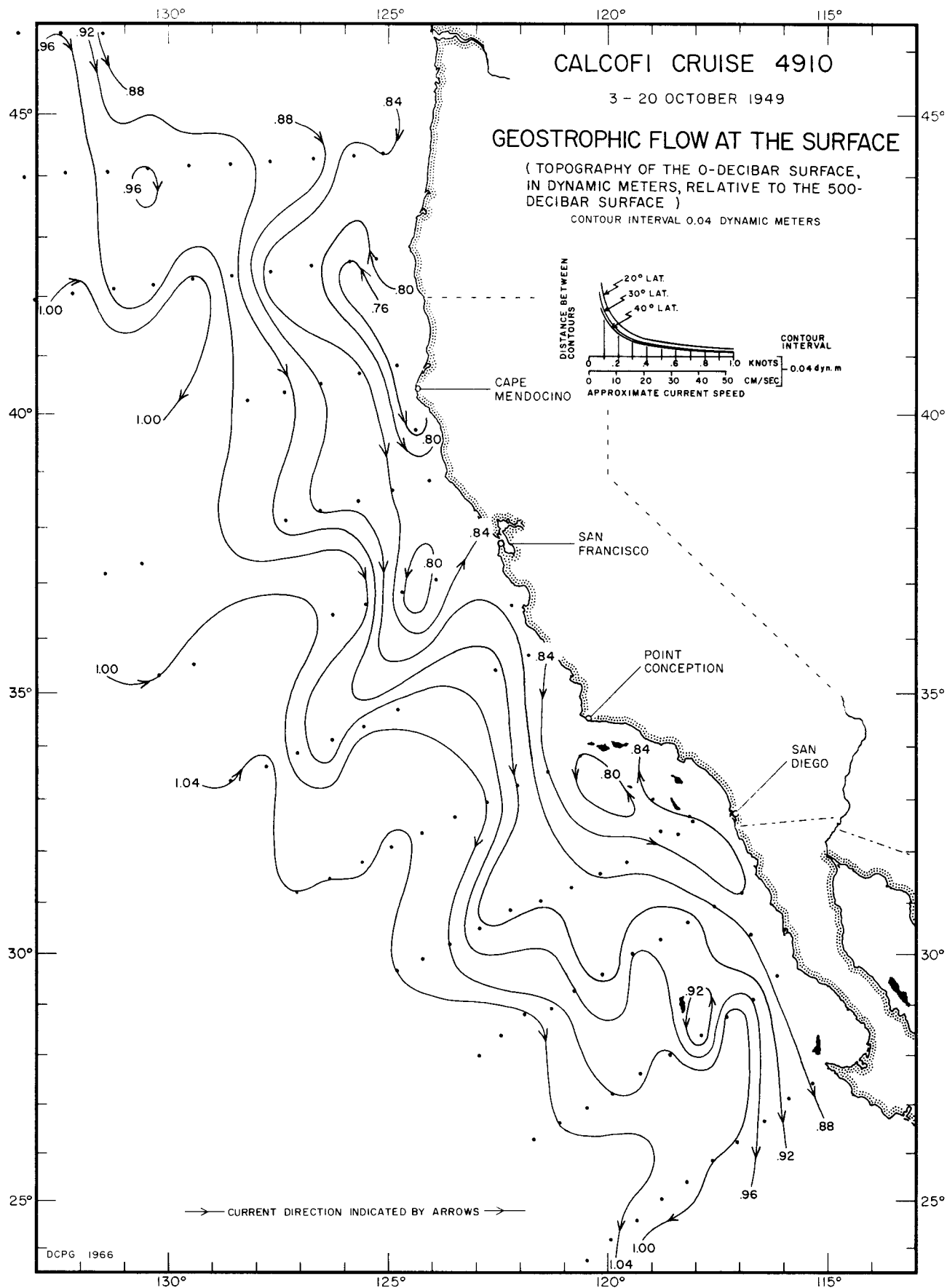


0/500 db  
4908

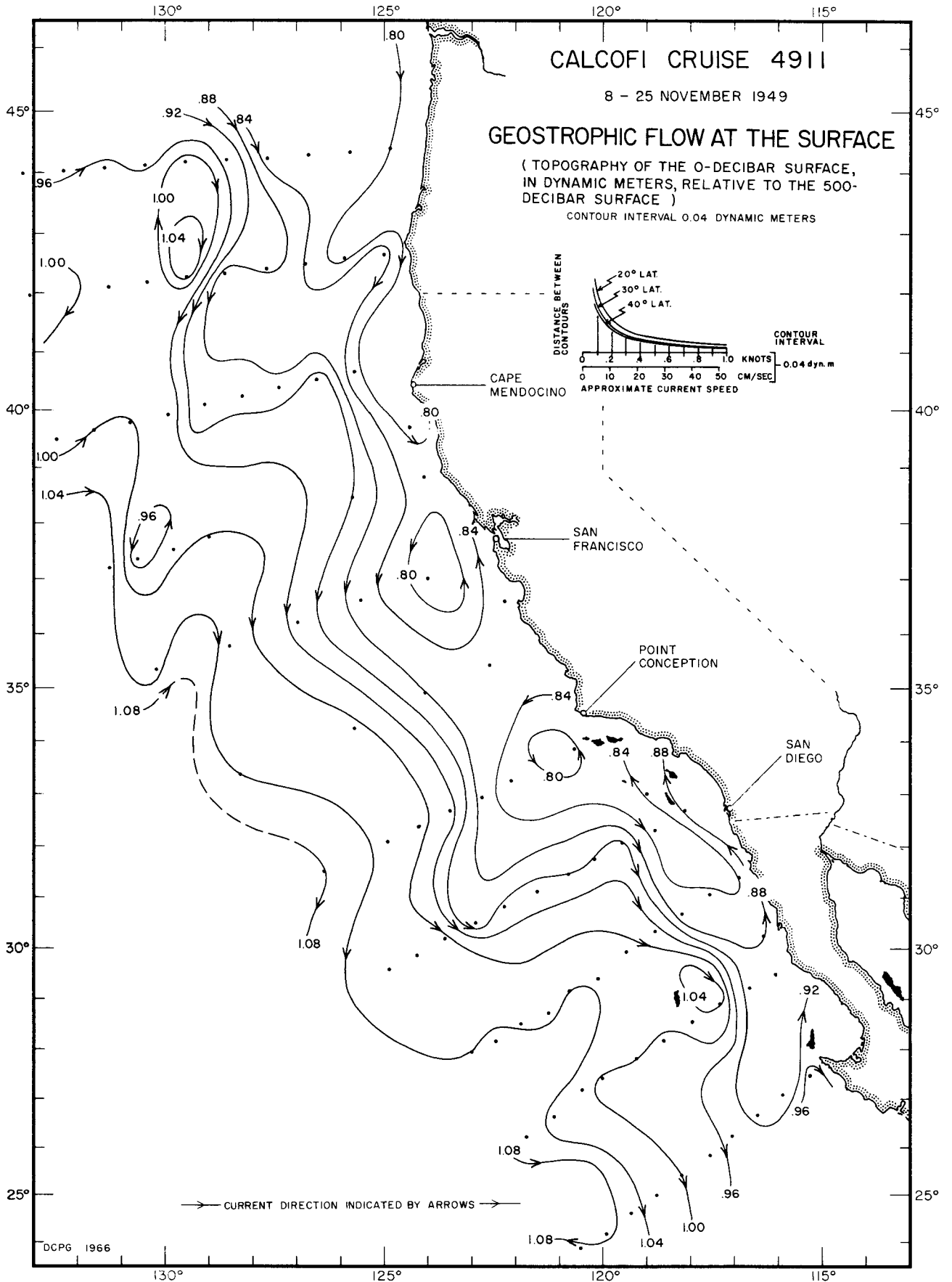


DCPG 1966

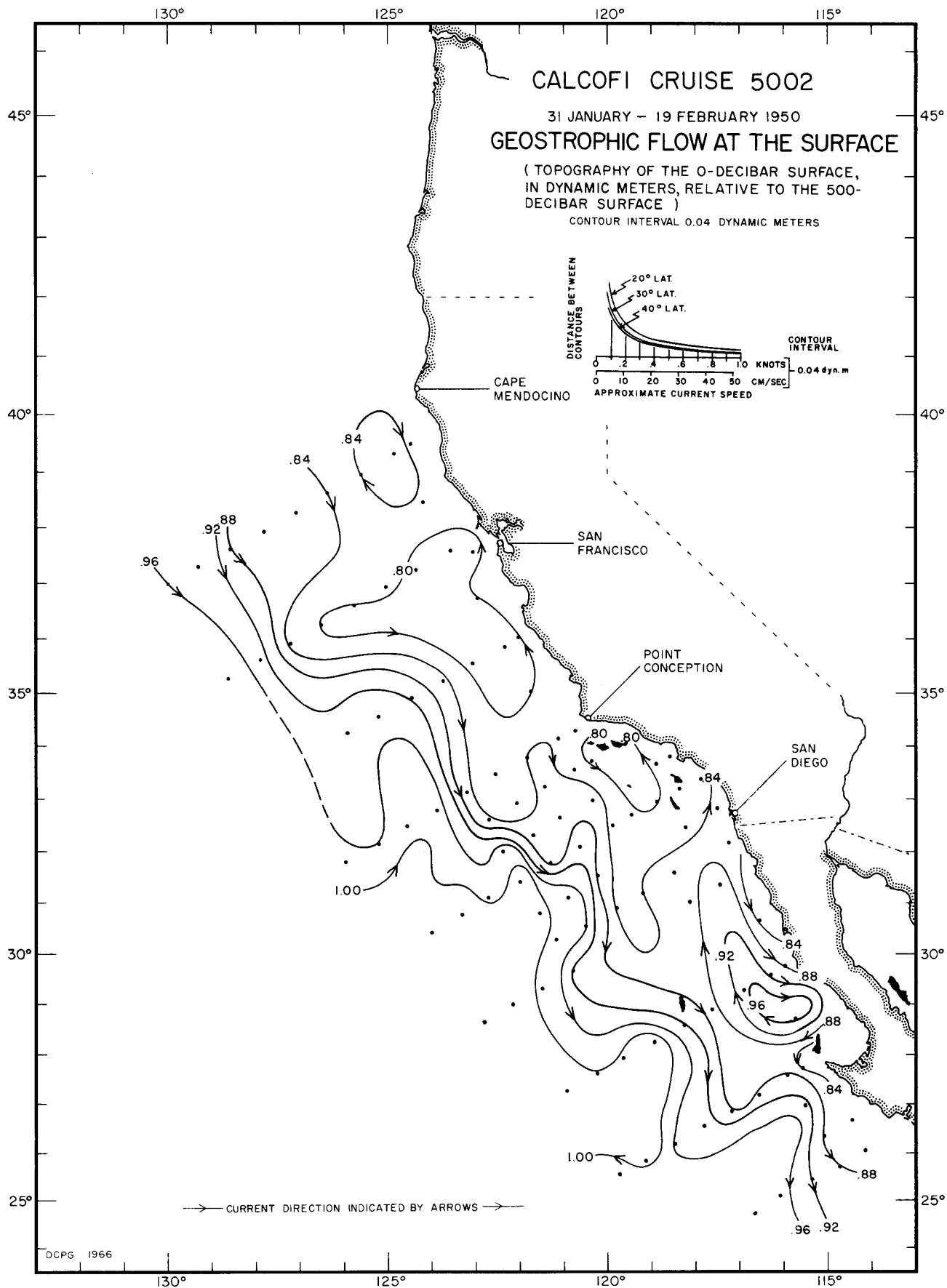
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0/500 db  
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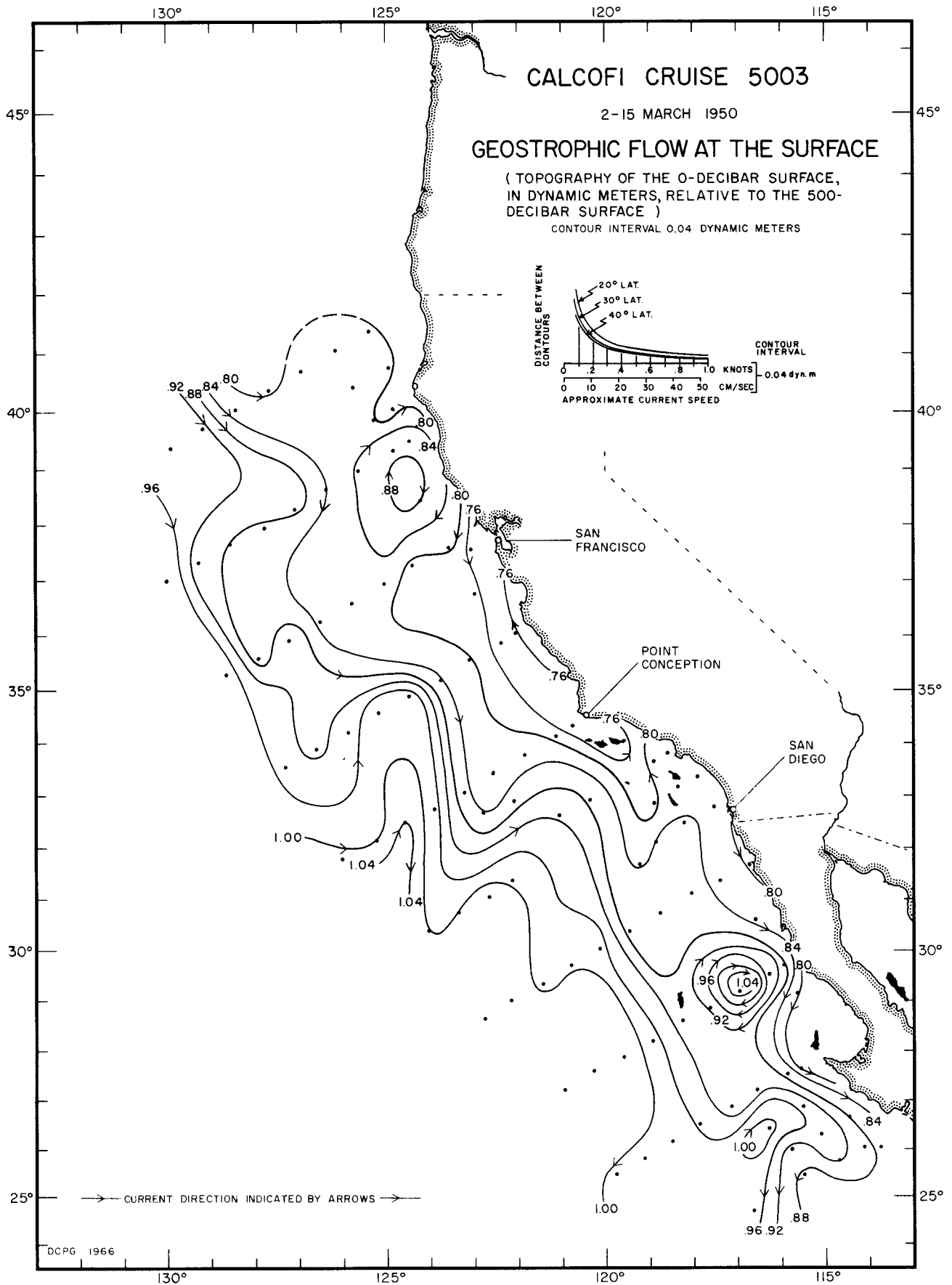


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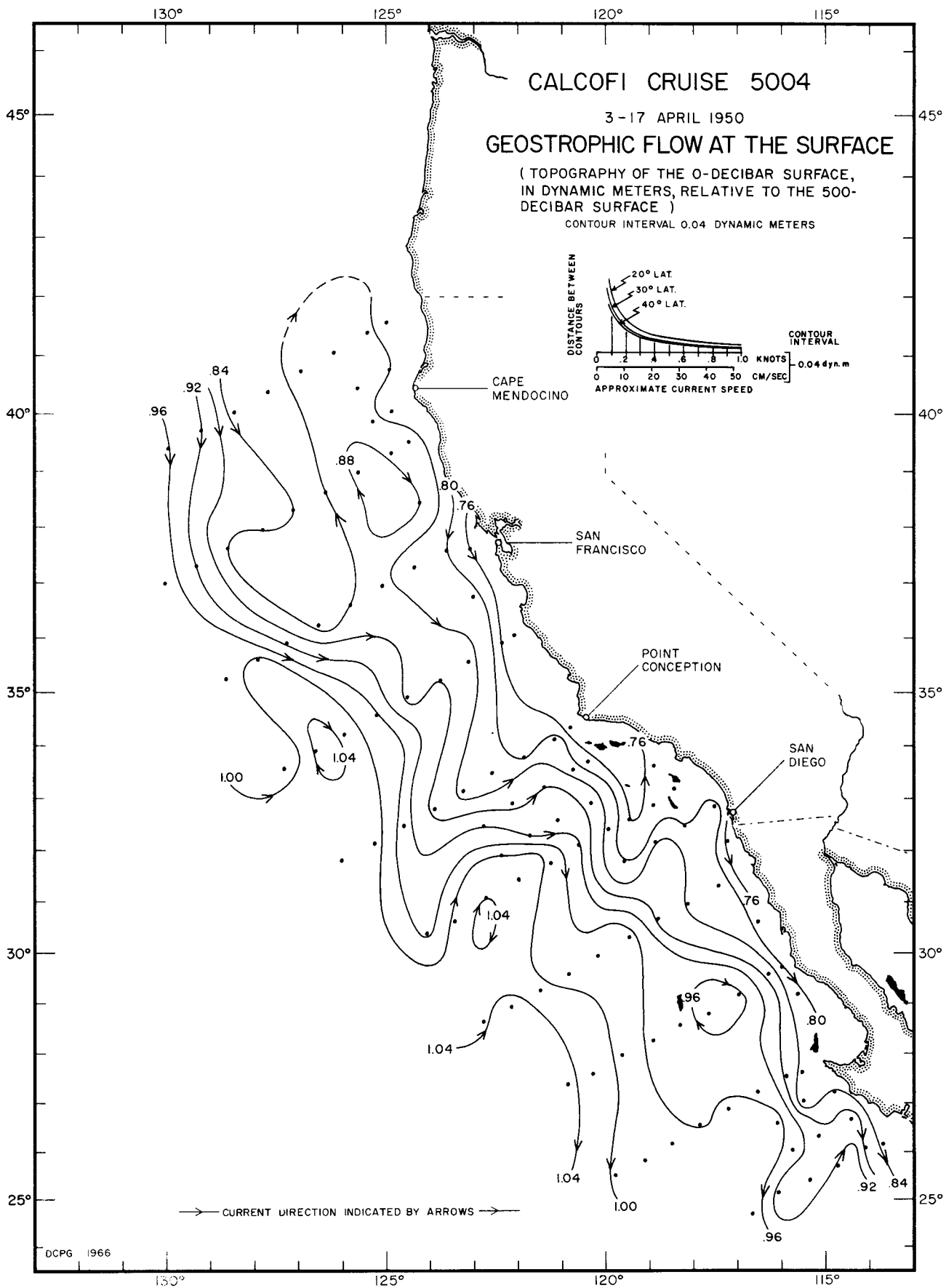


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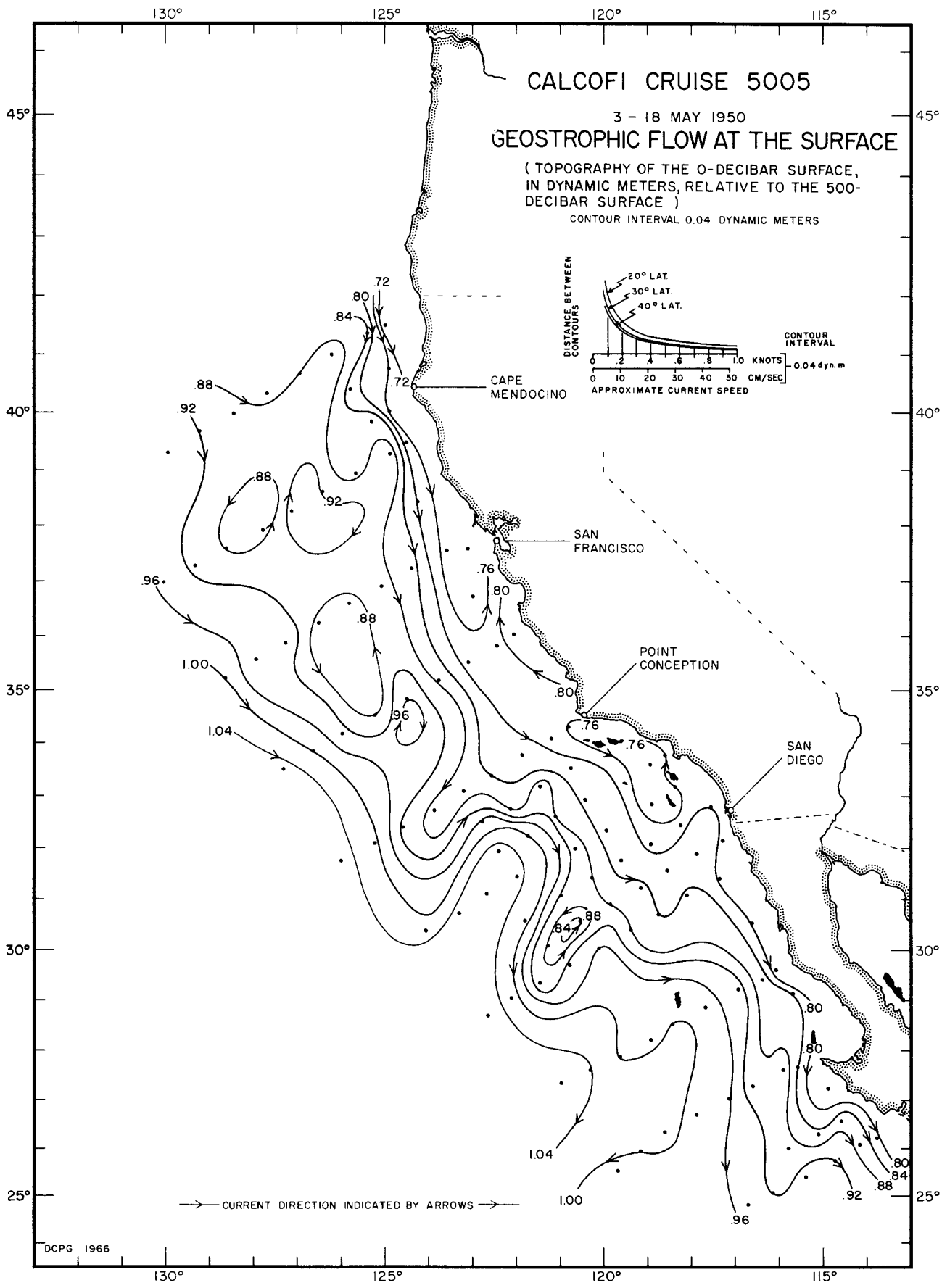




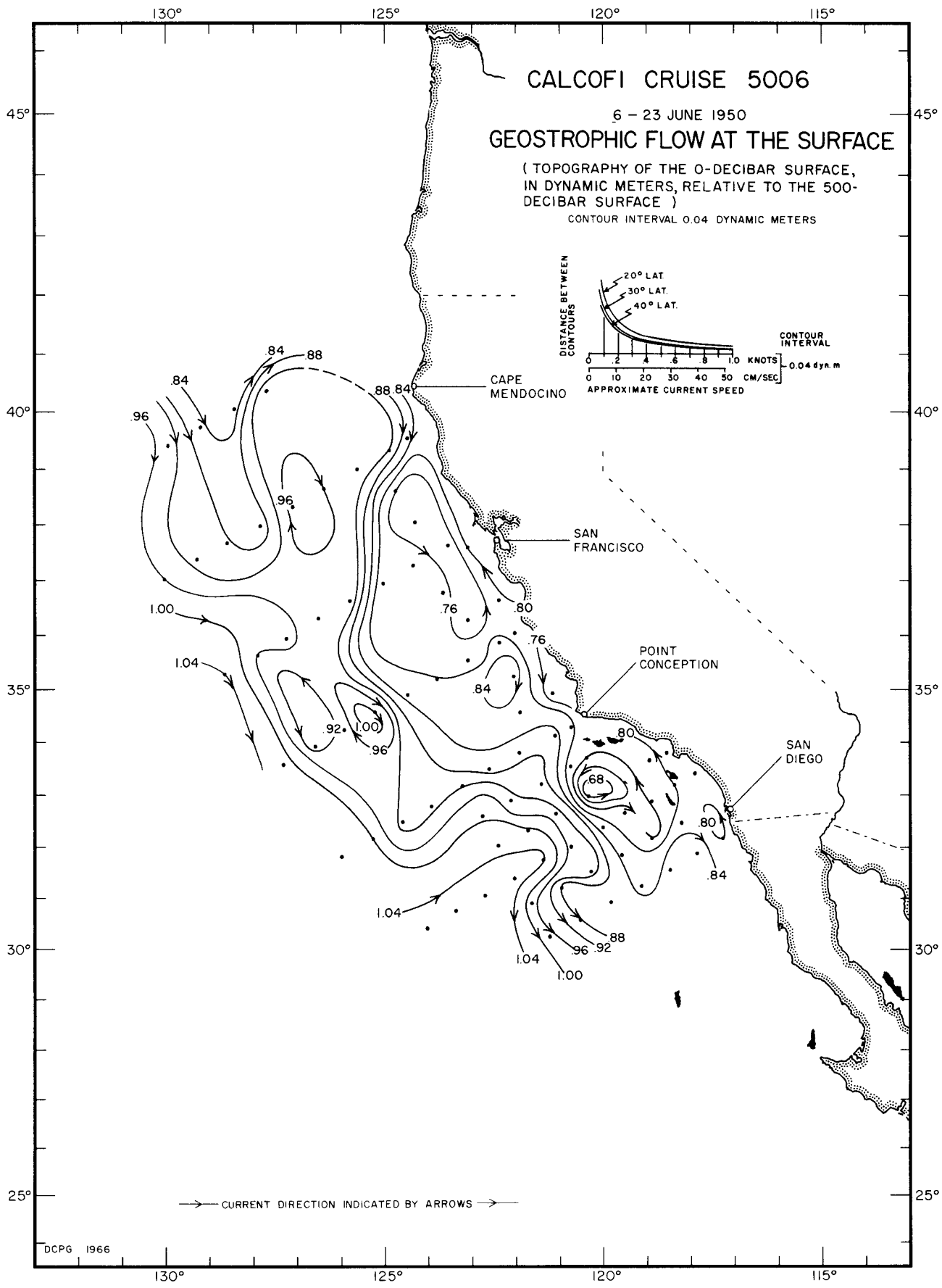
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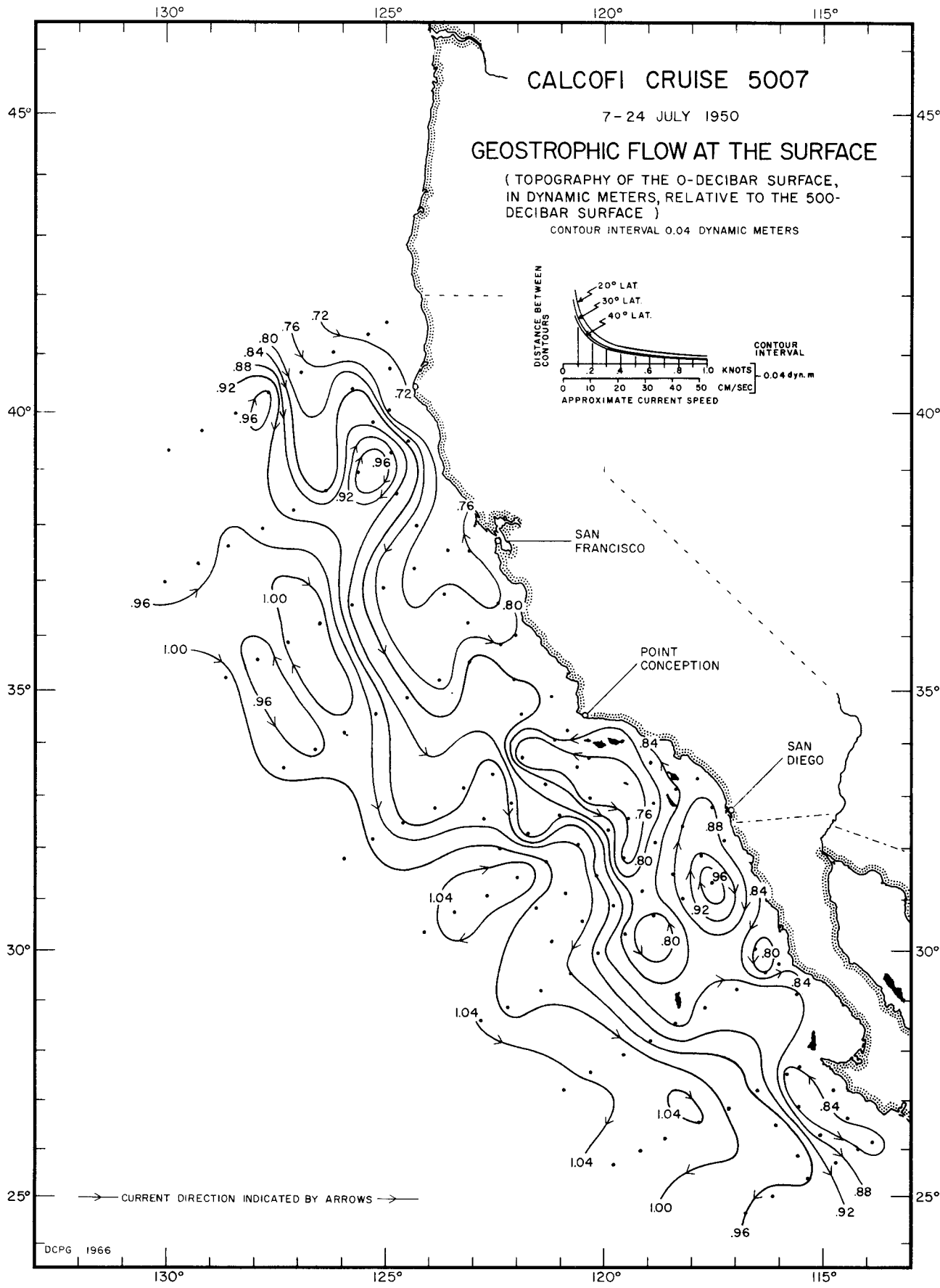
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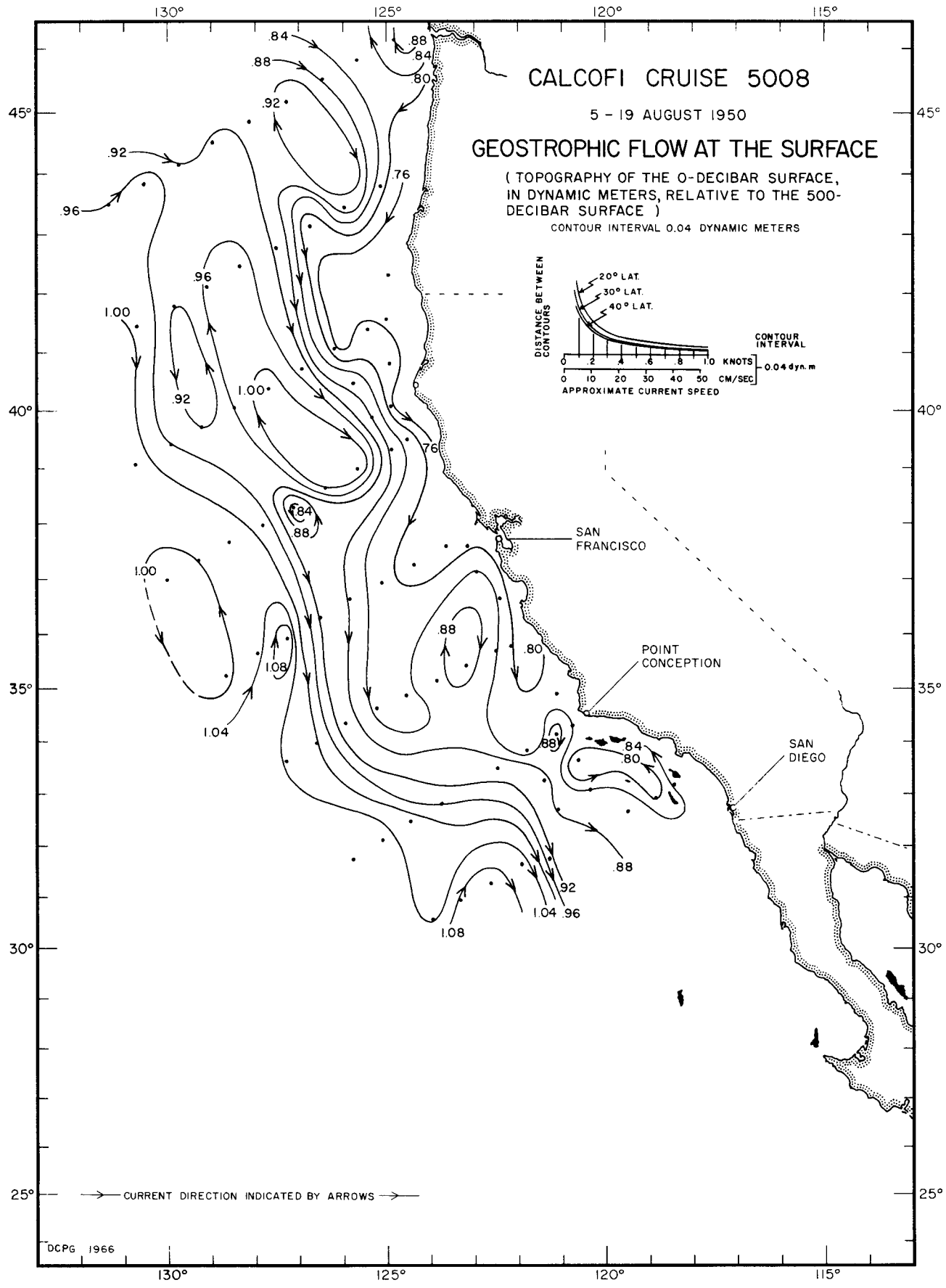
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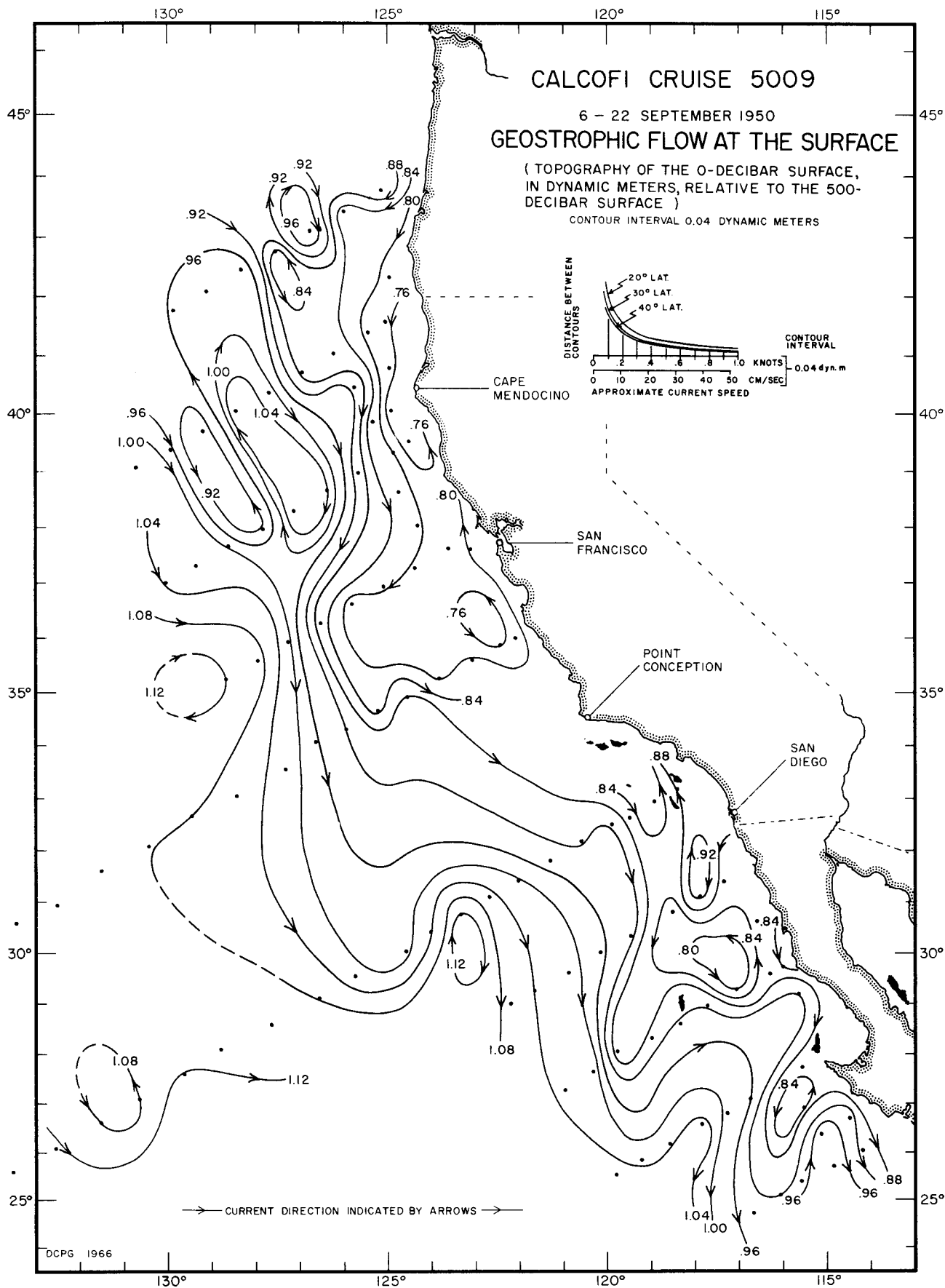
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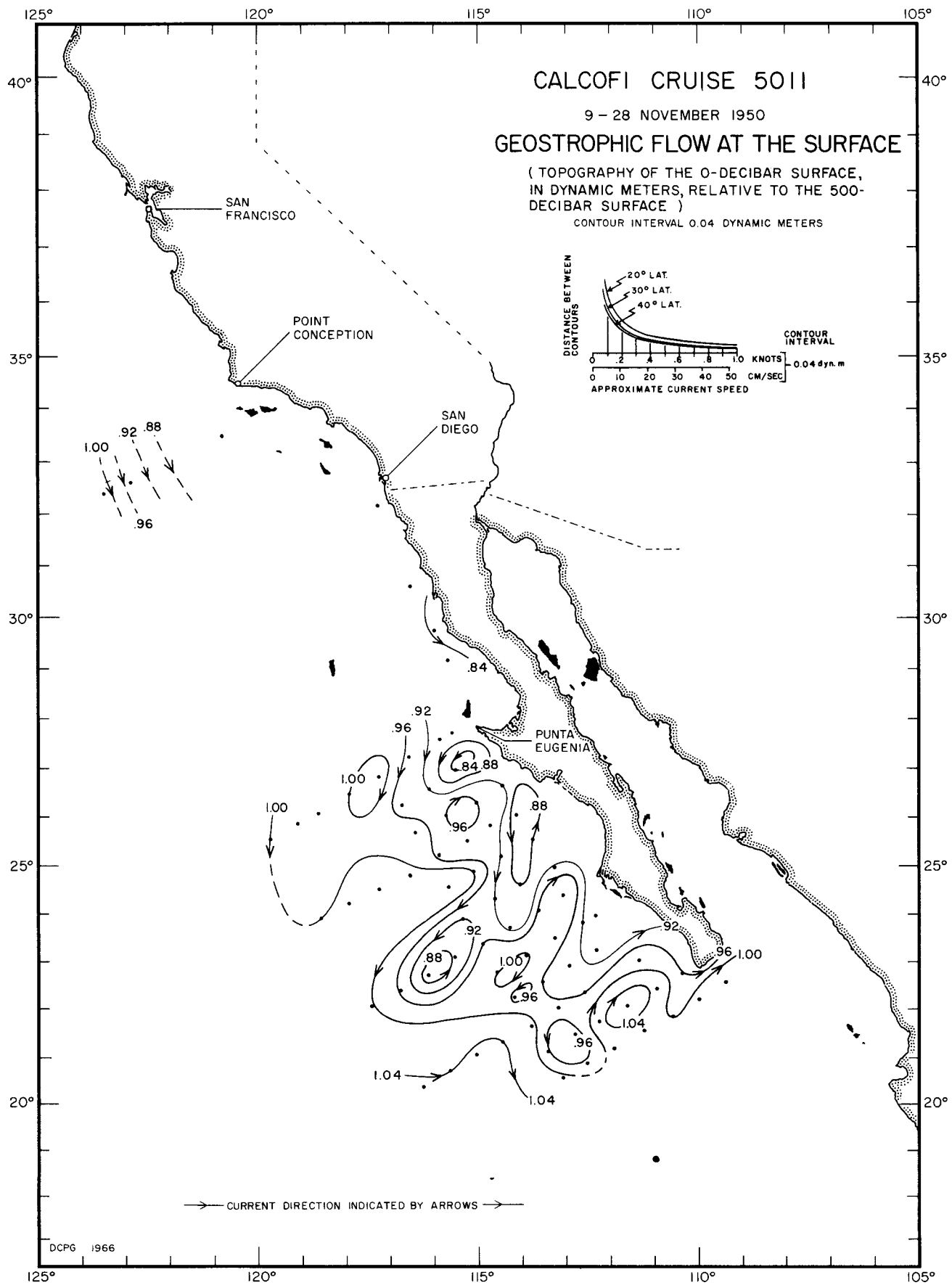
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0/500 db  
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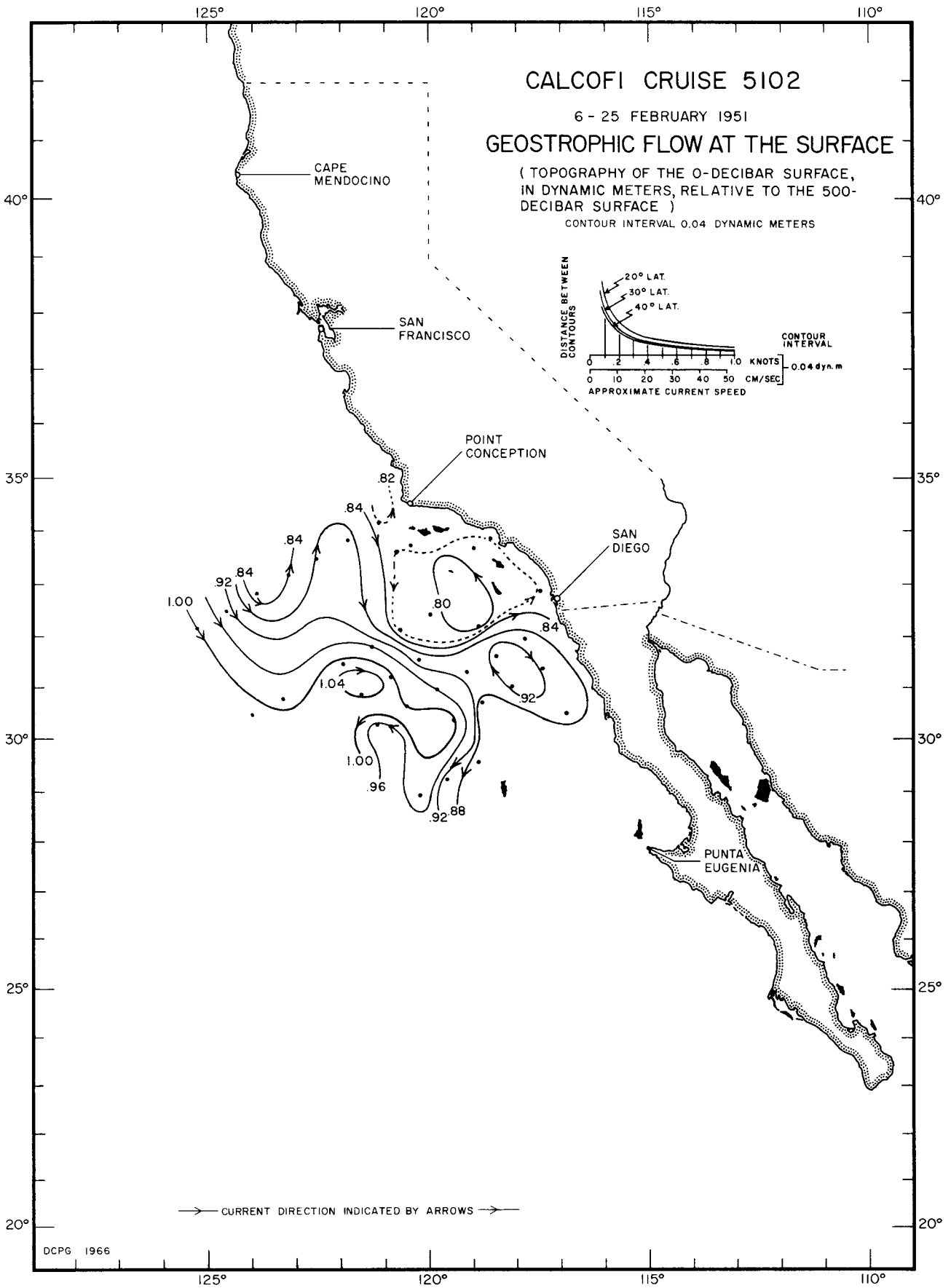
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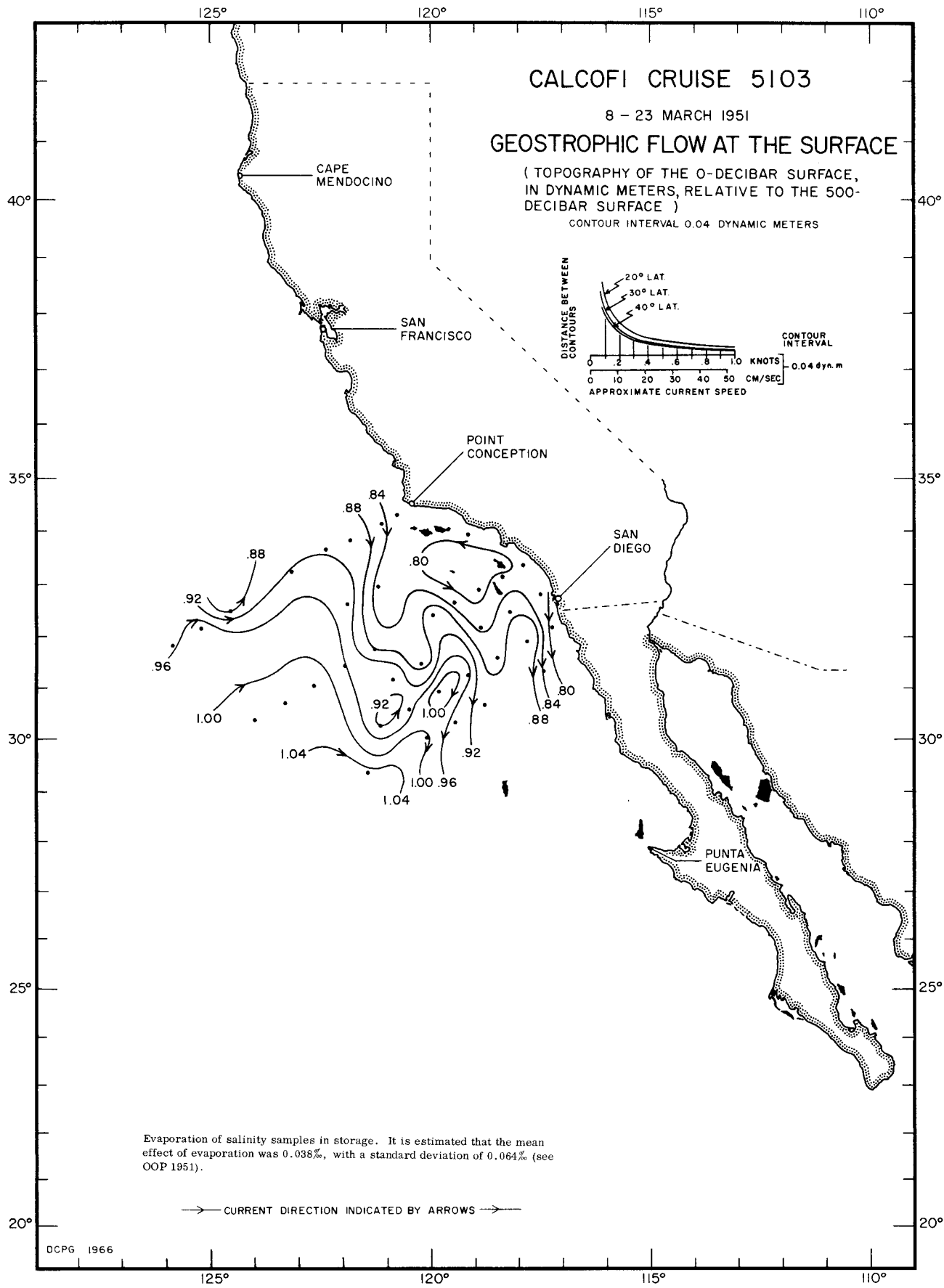
DCP6 1966

O/500 db  
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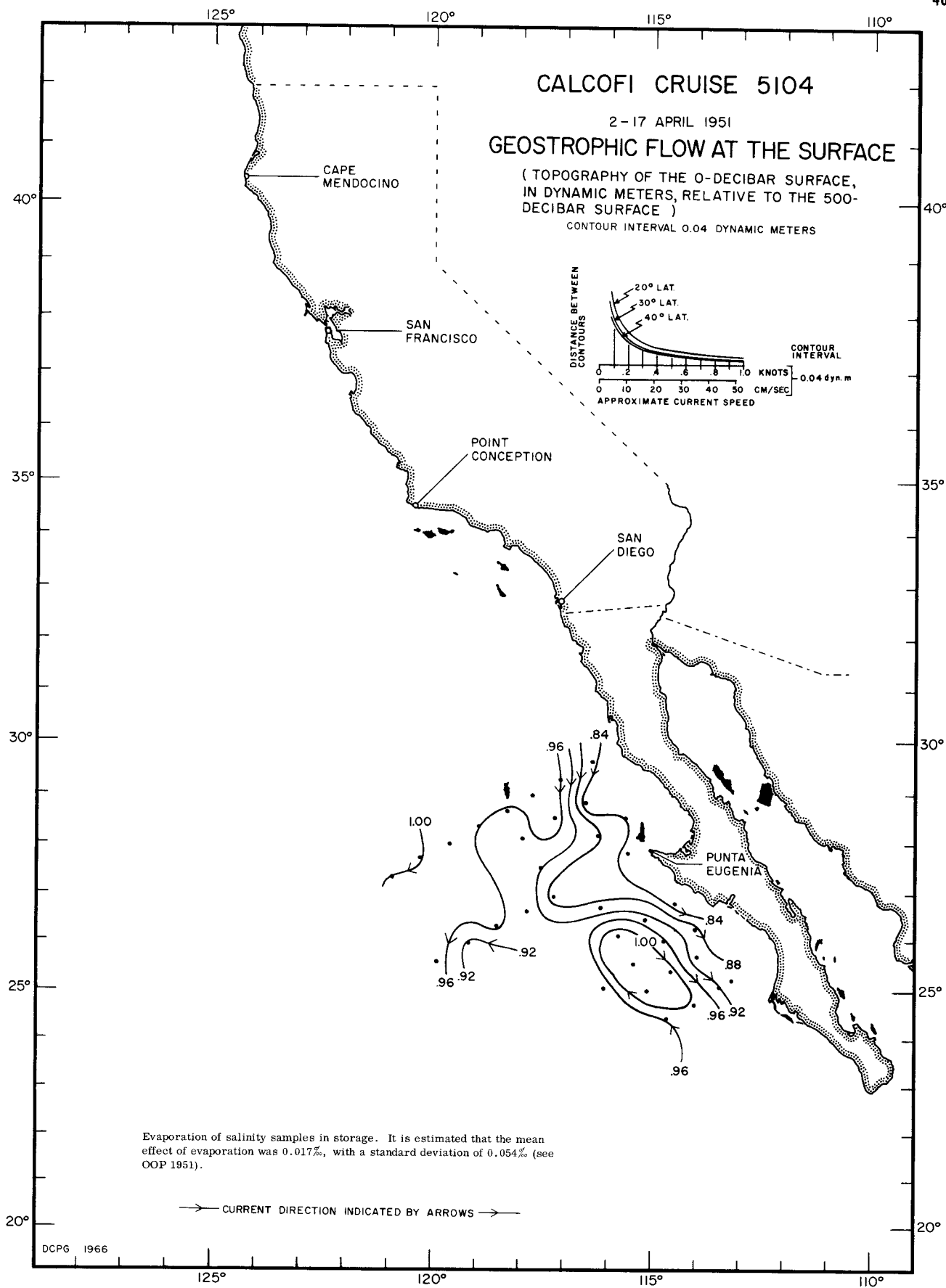


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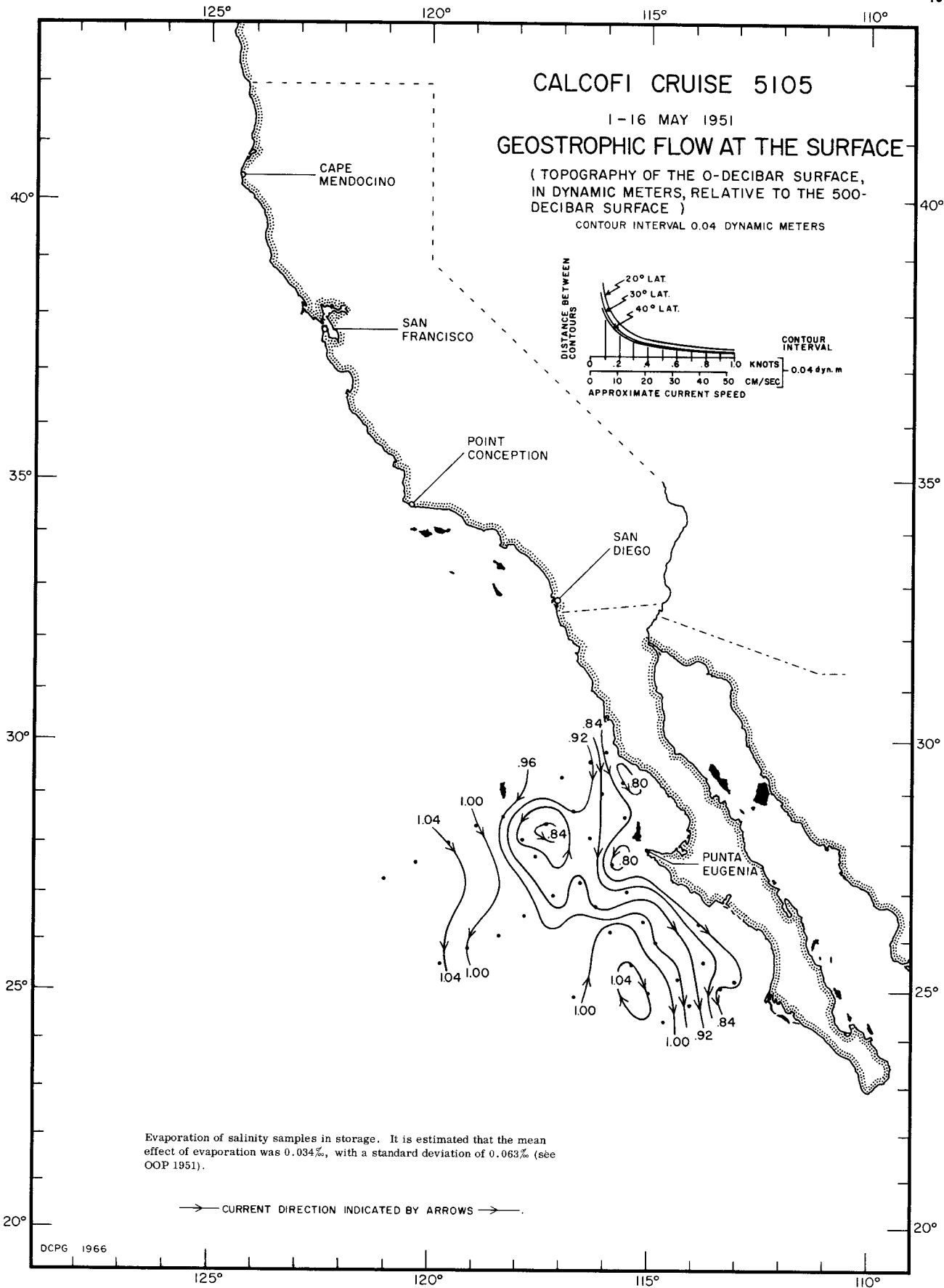


DCPG 1966

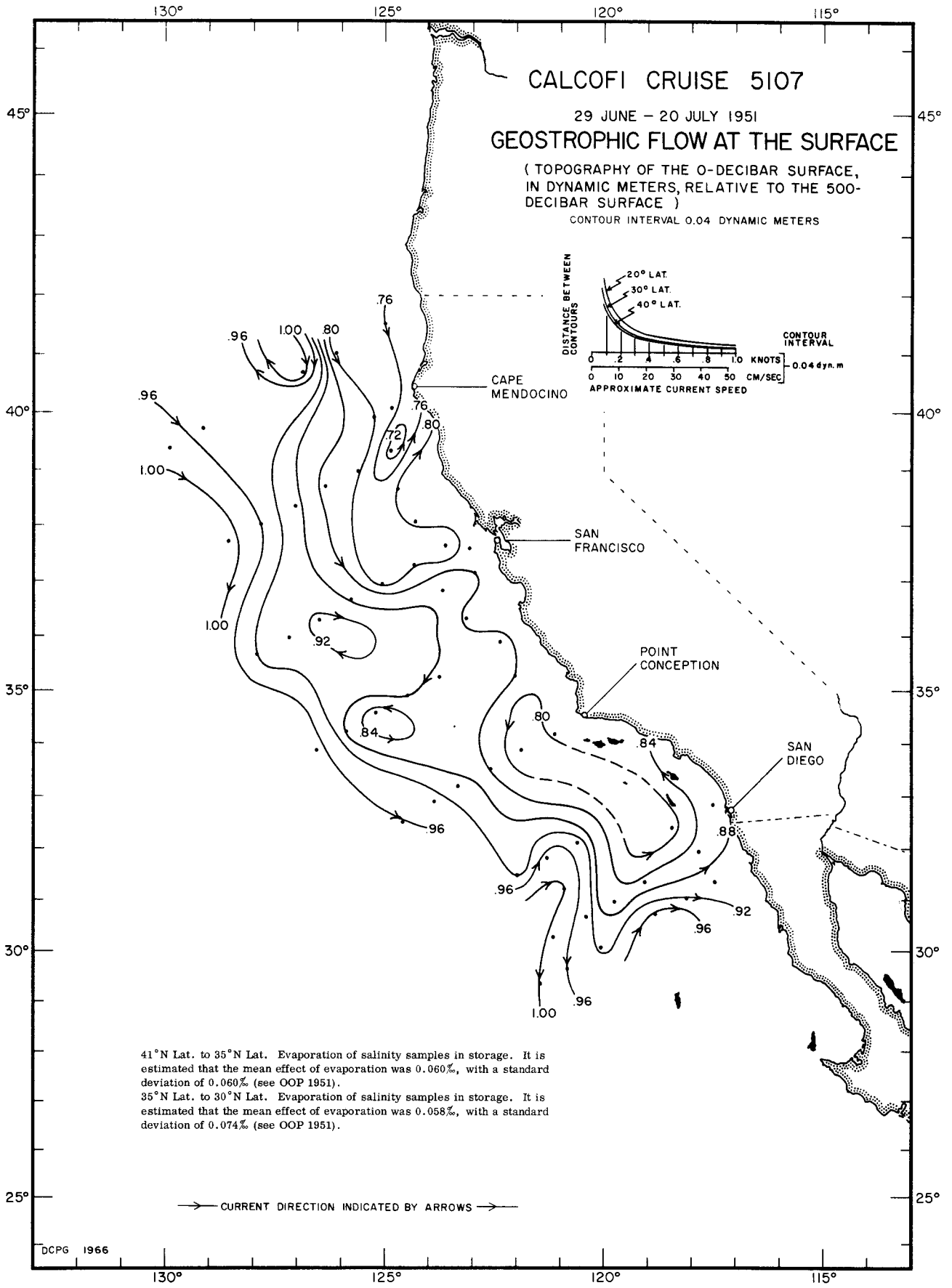
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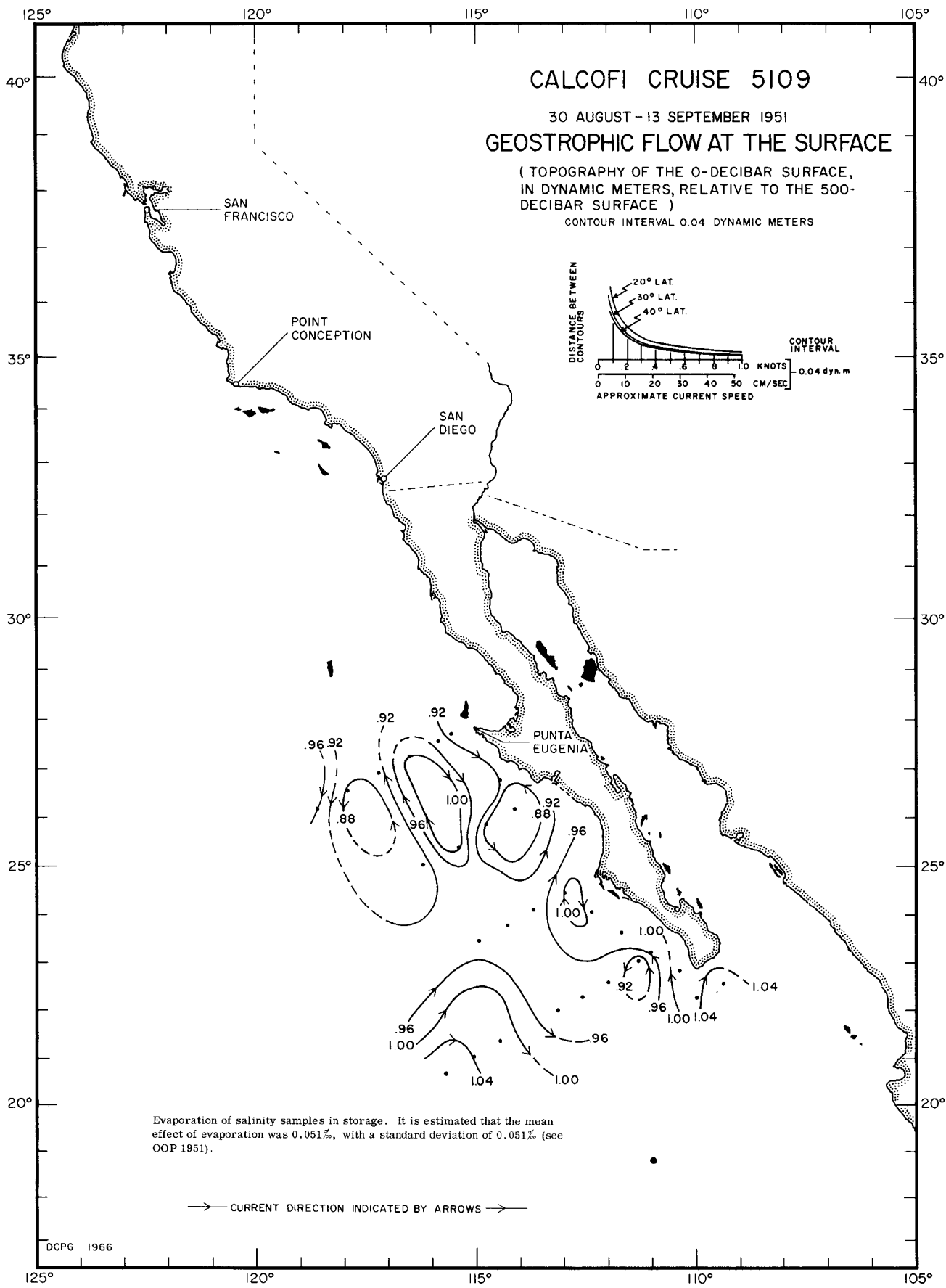
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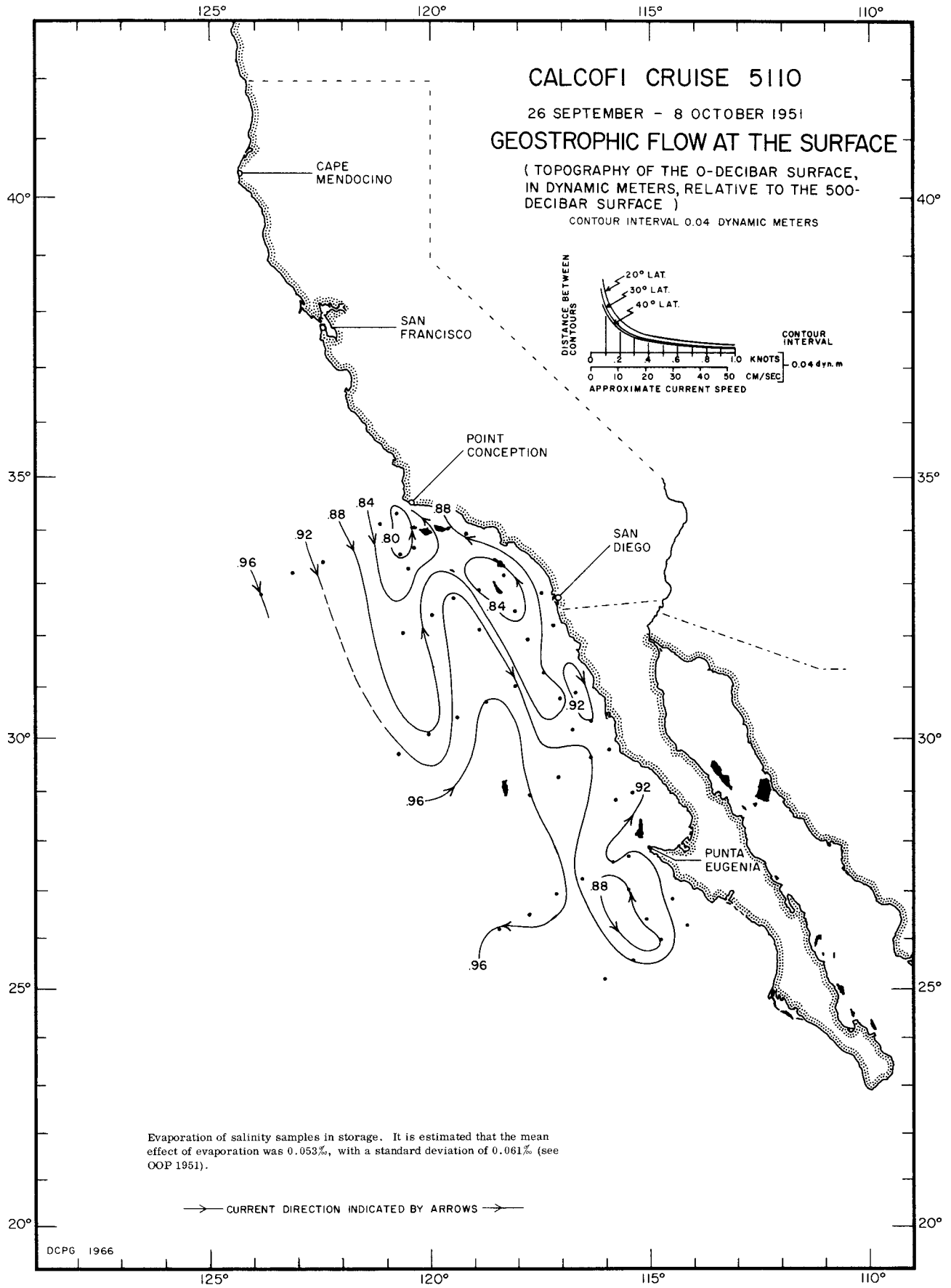
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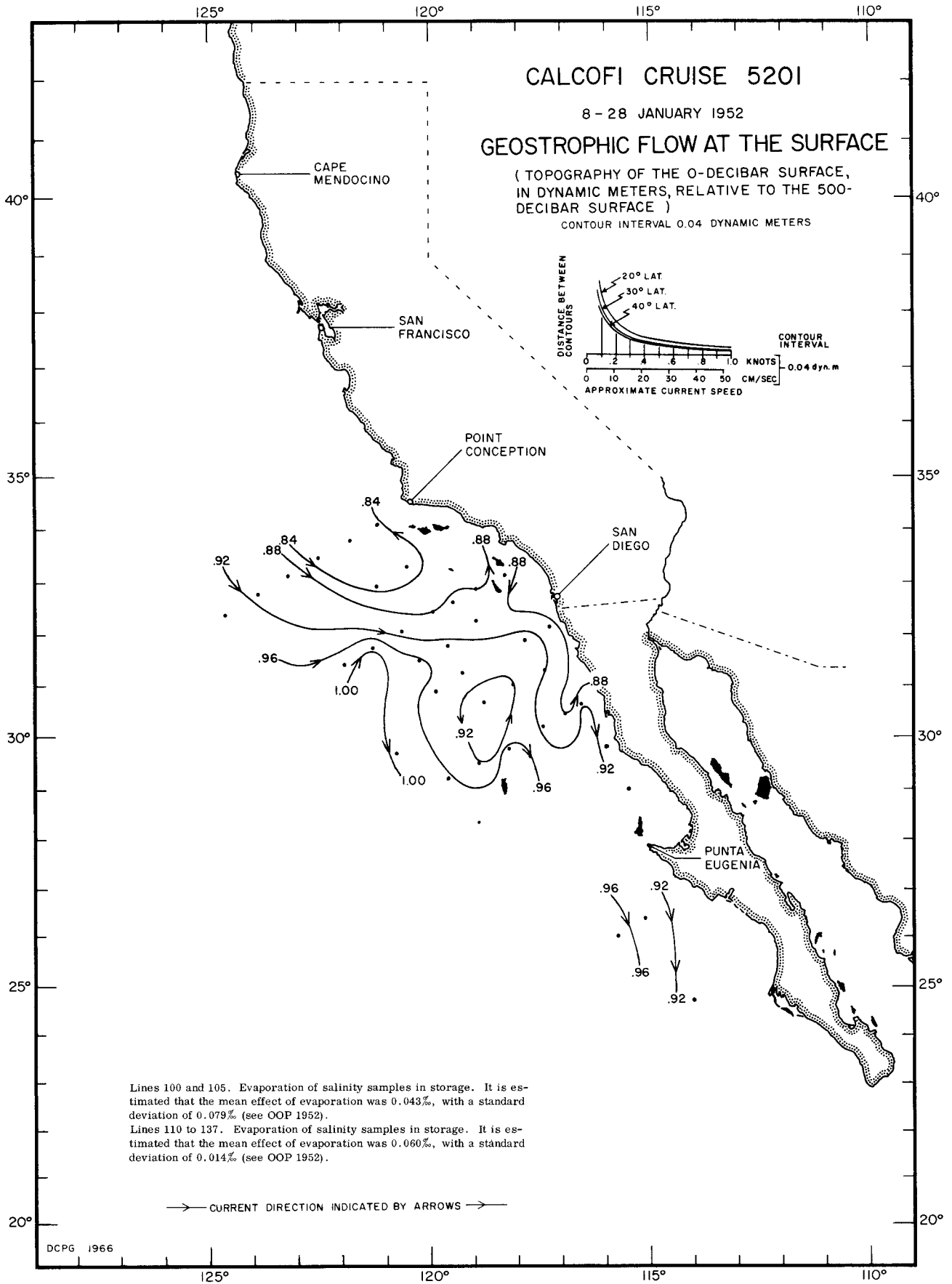
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O/500 db  
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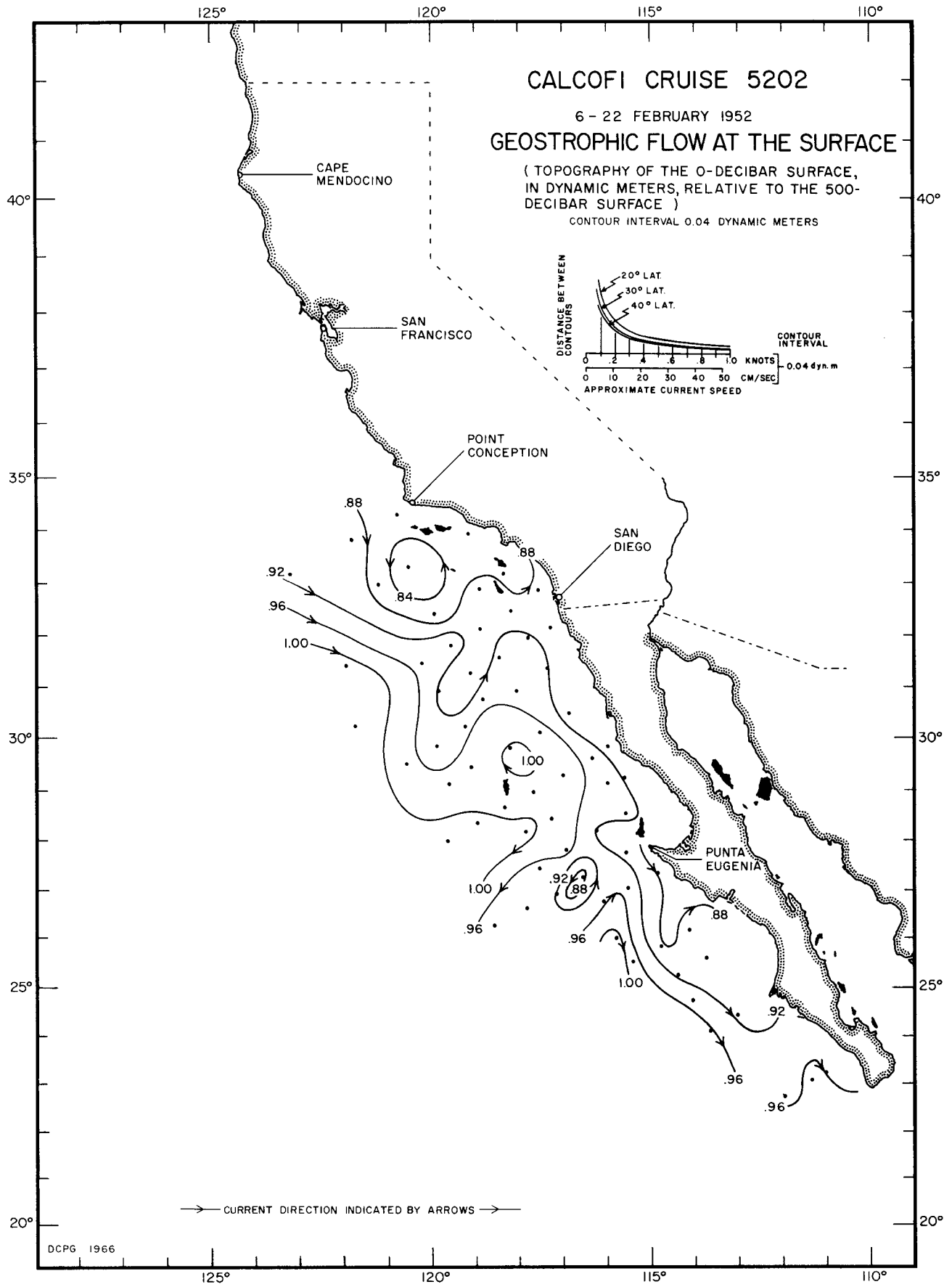


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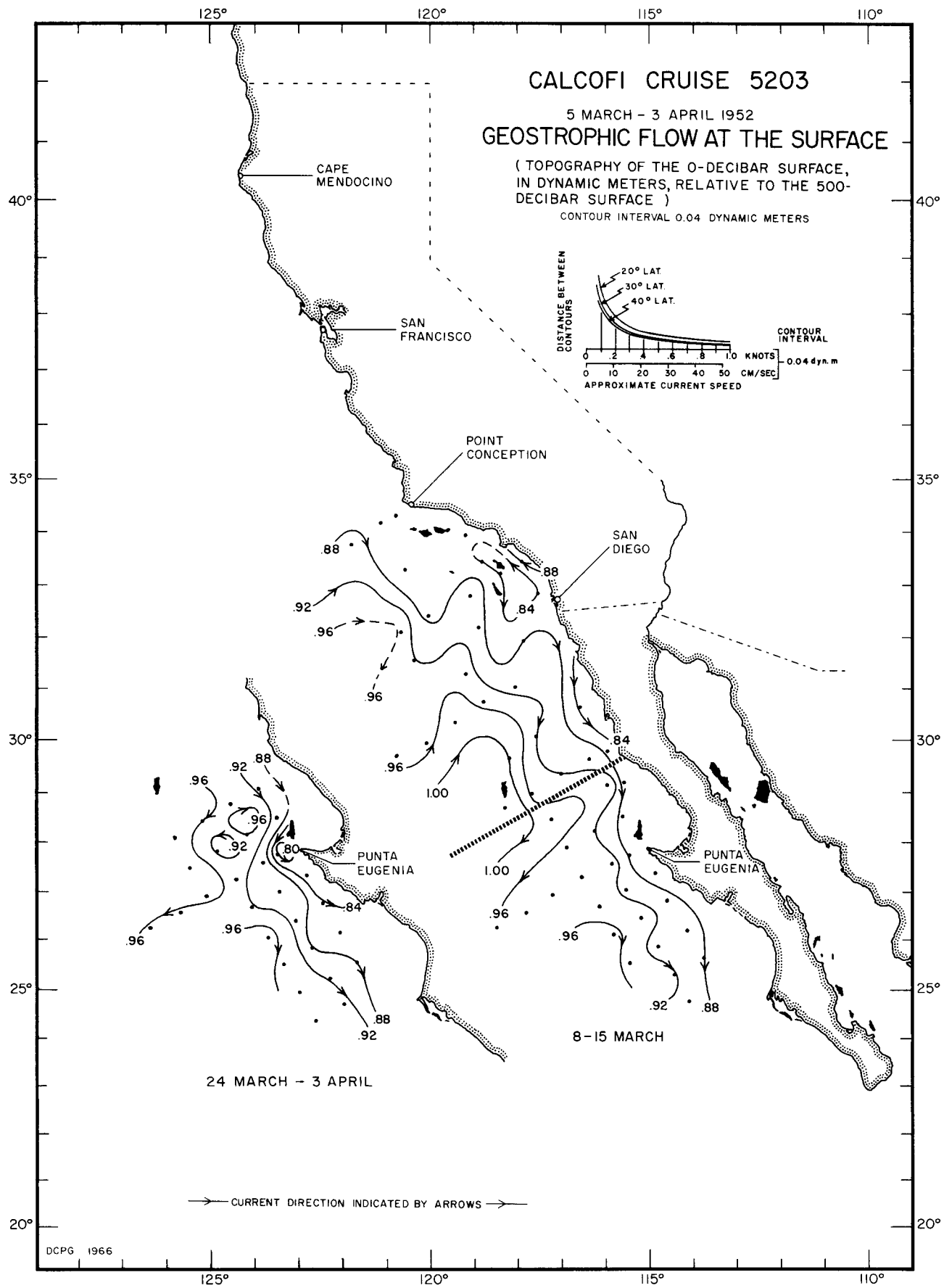
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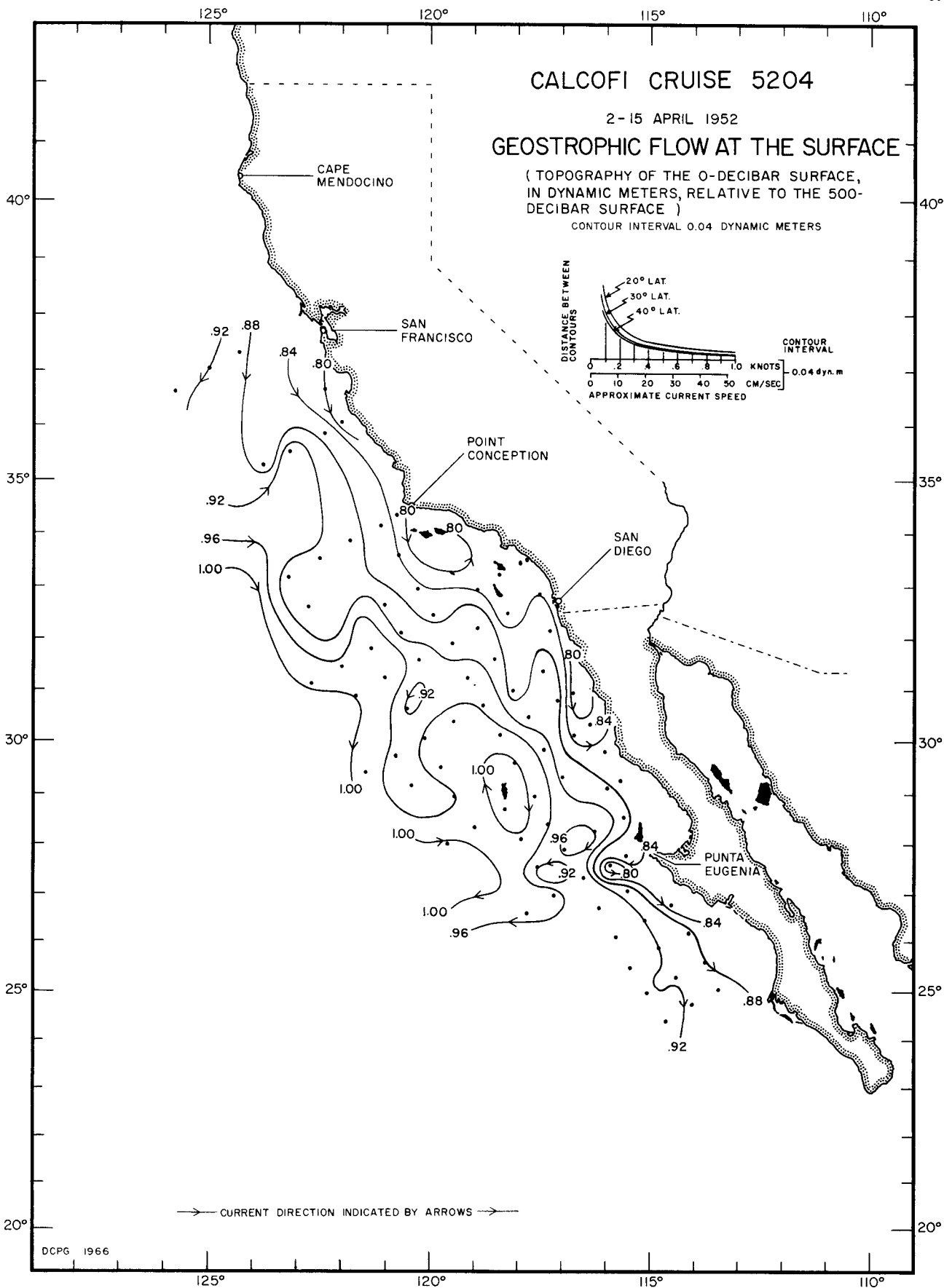
DCPG 1966

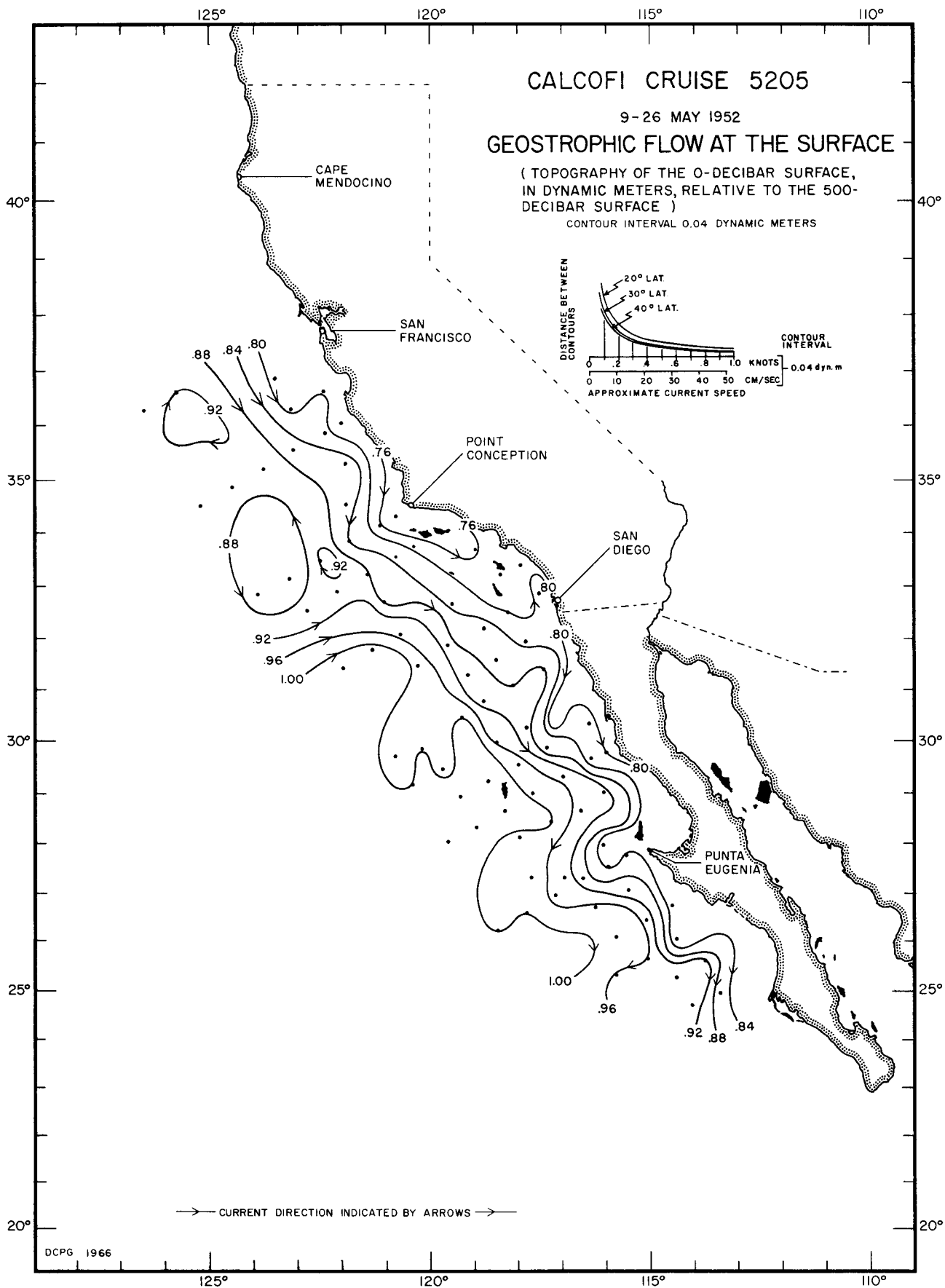
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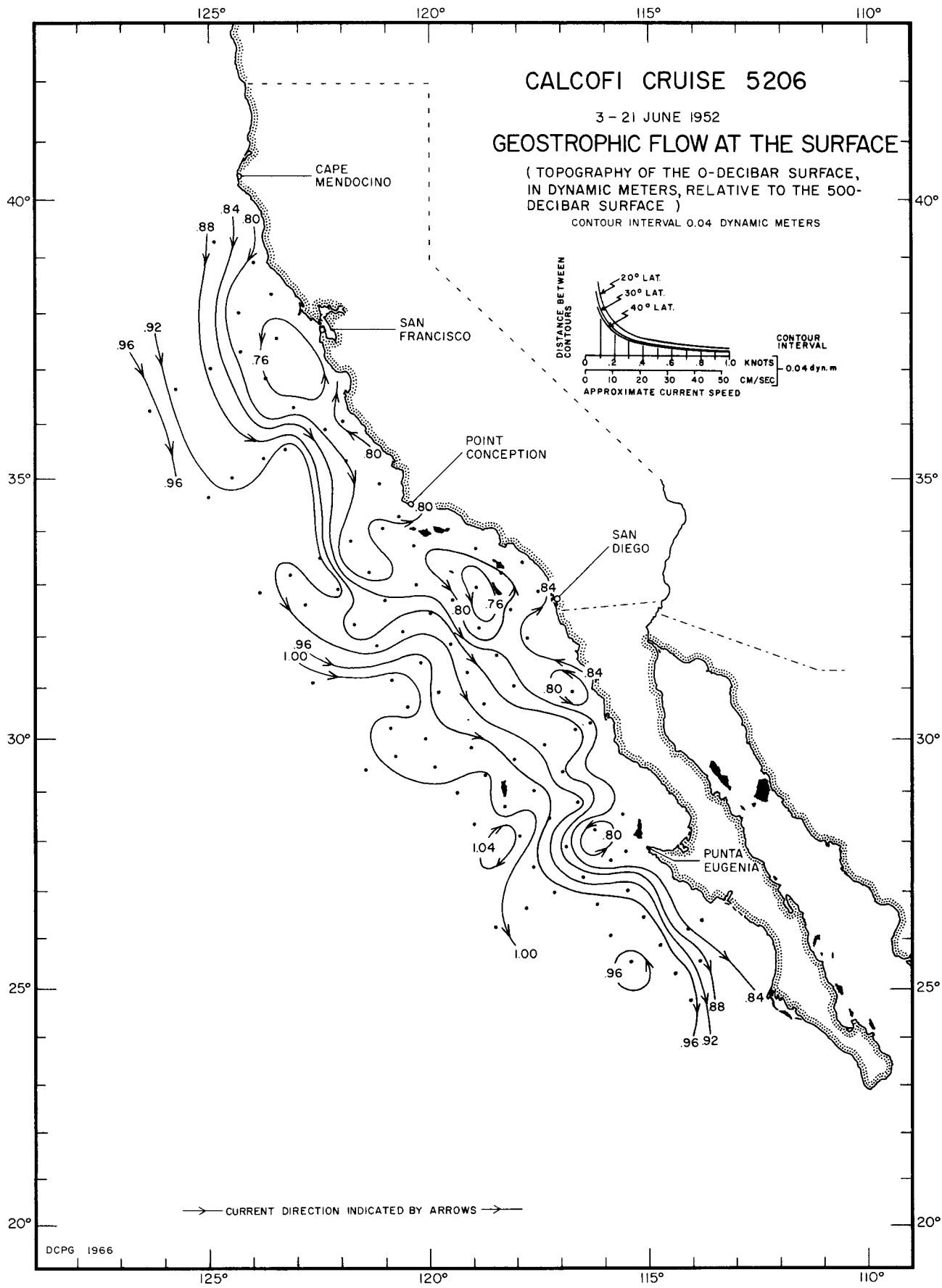
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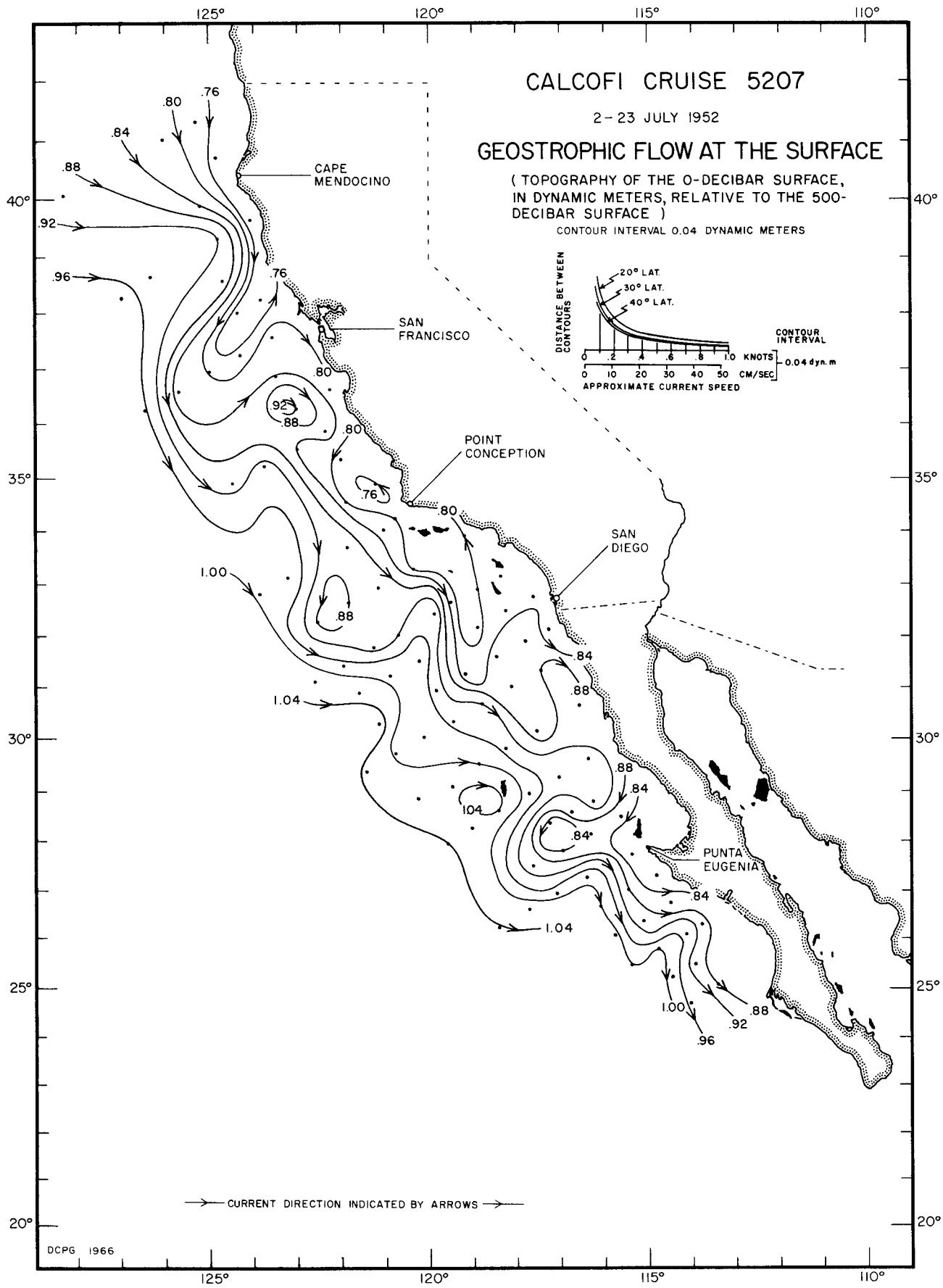


O/500 db  
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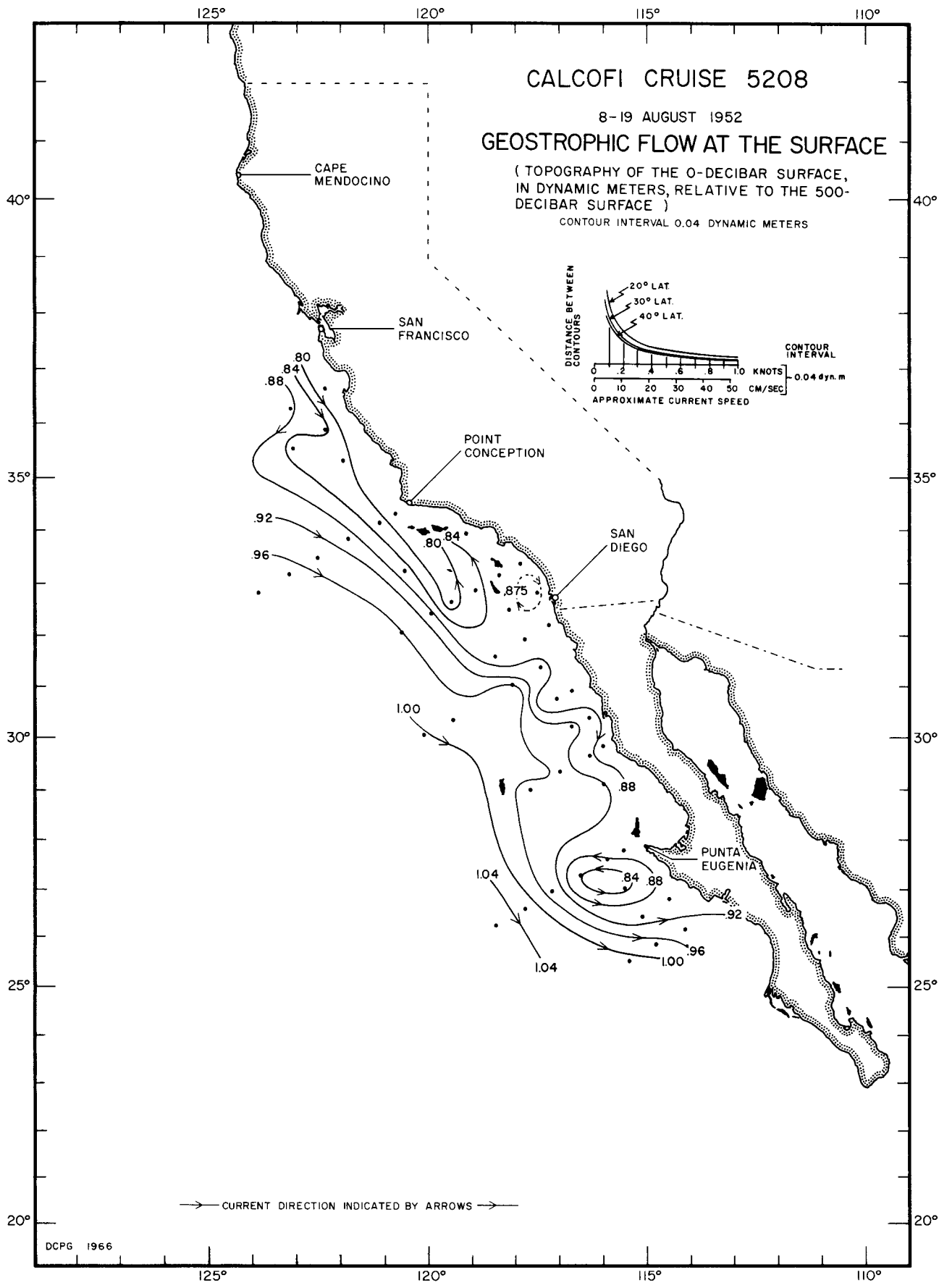


DCPG 1966

0/500 db  
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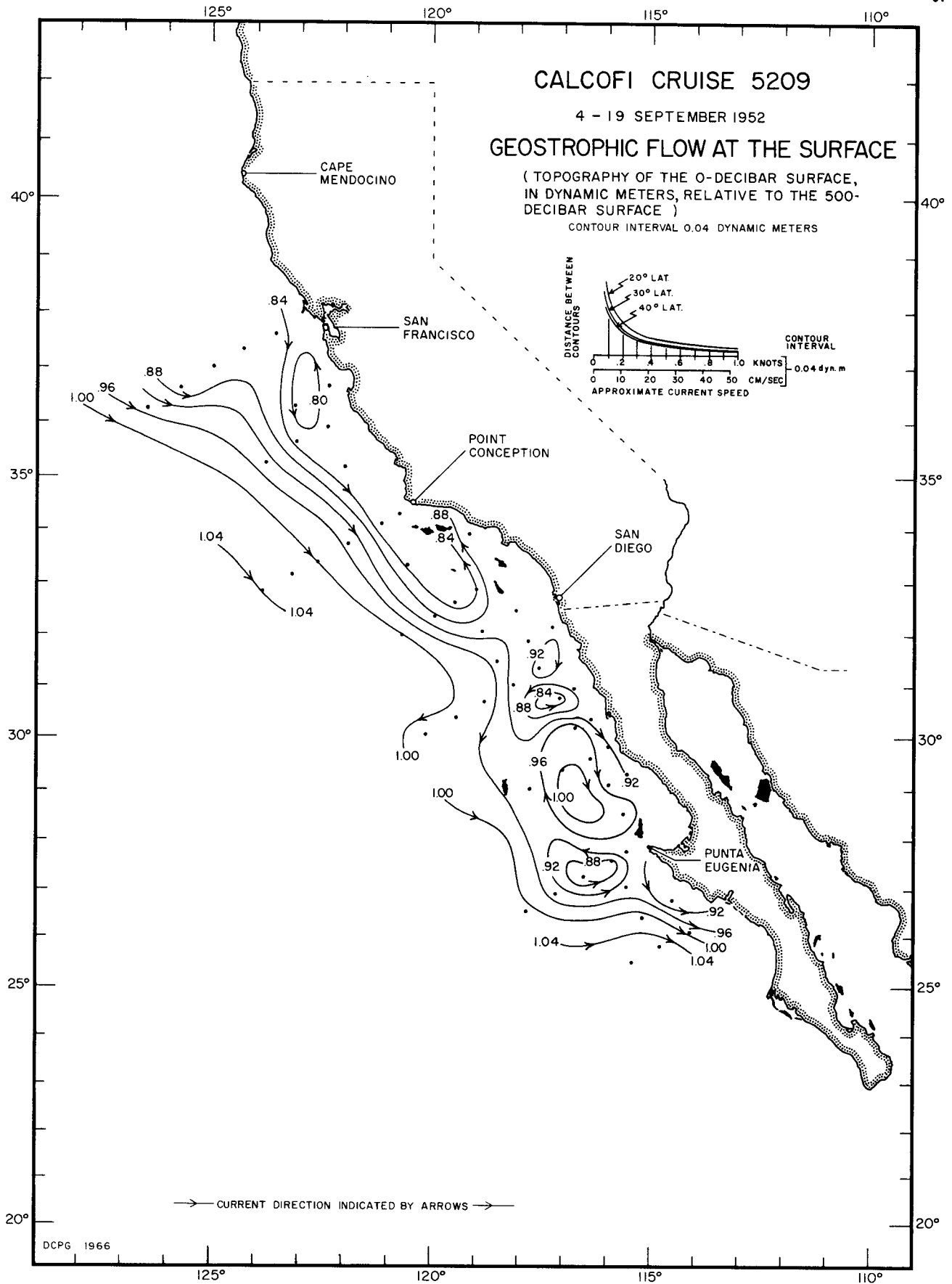


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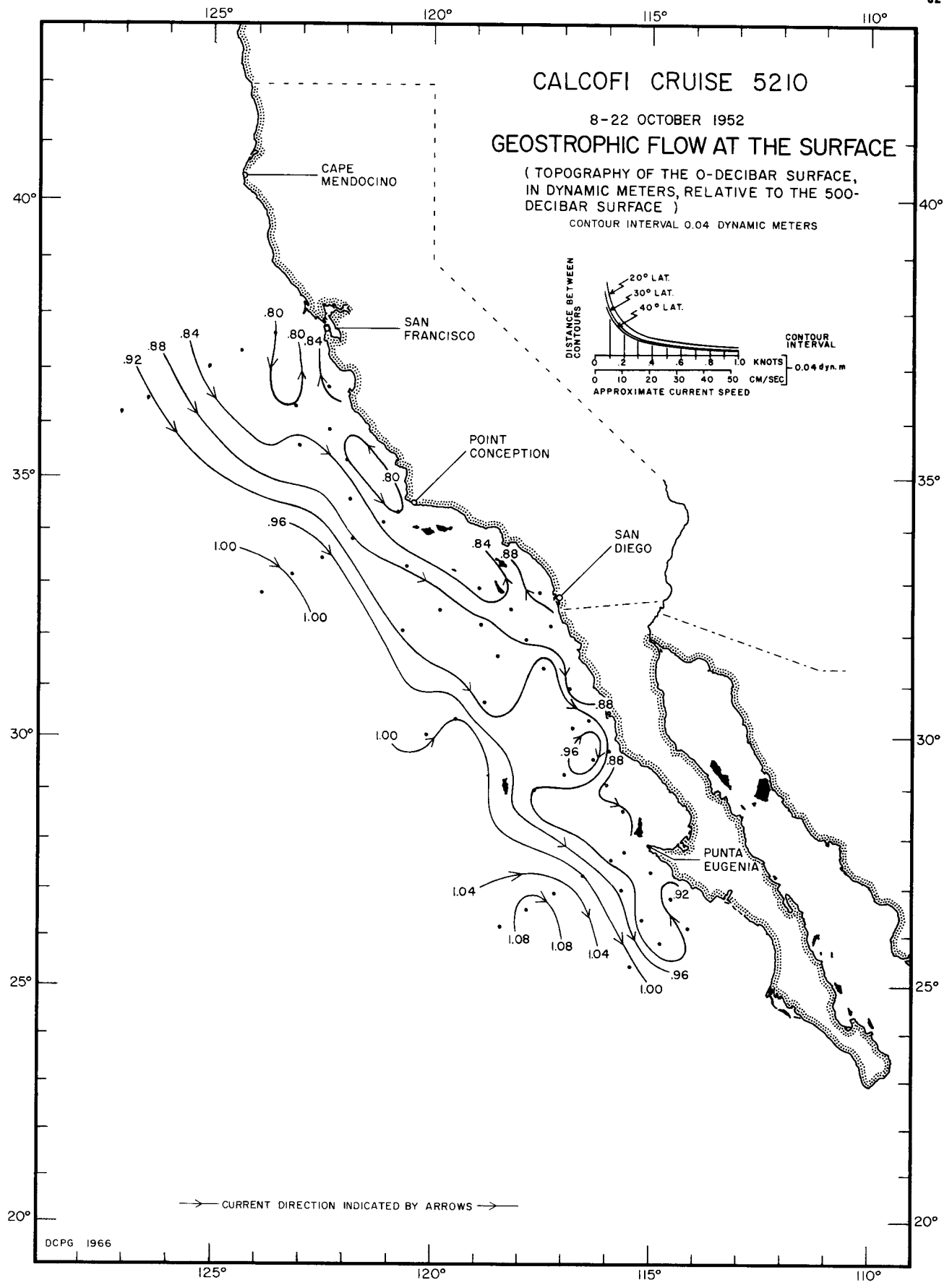
DCPG 1966

0/500 db  
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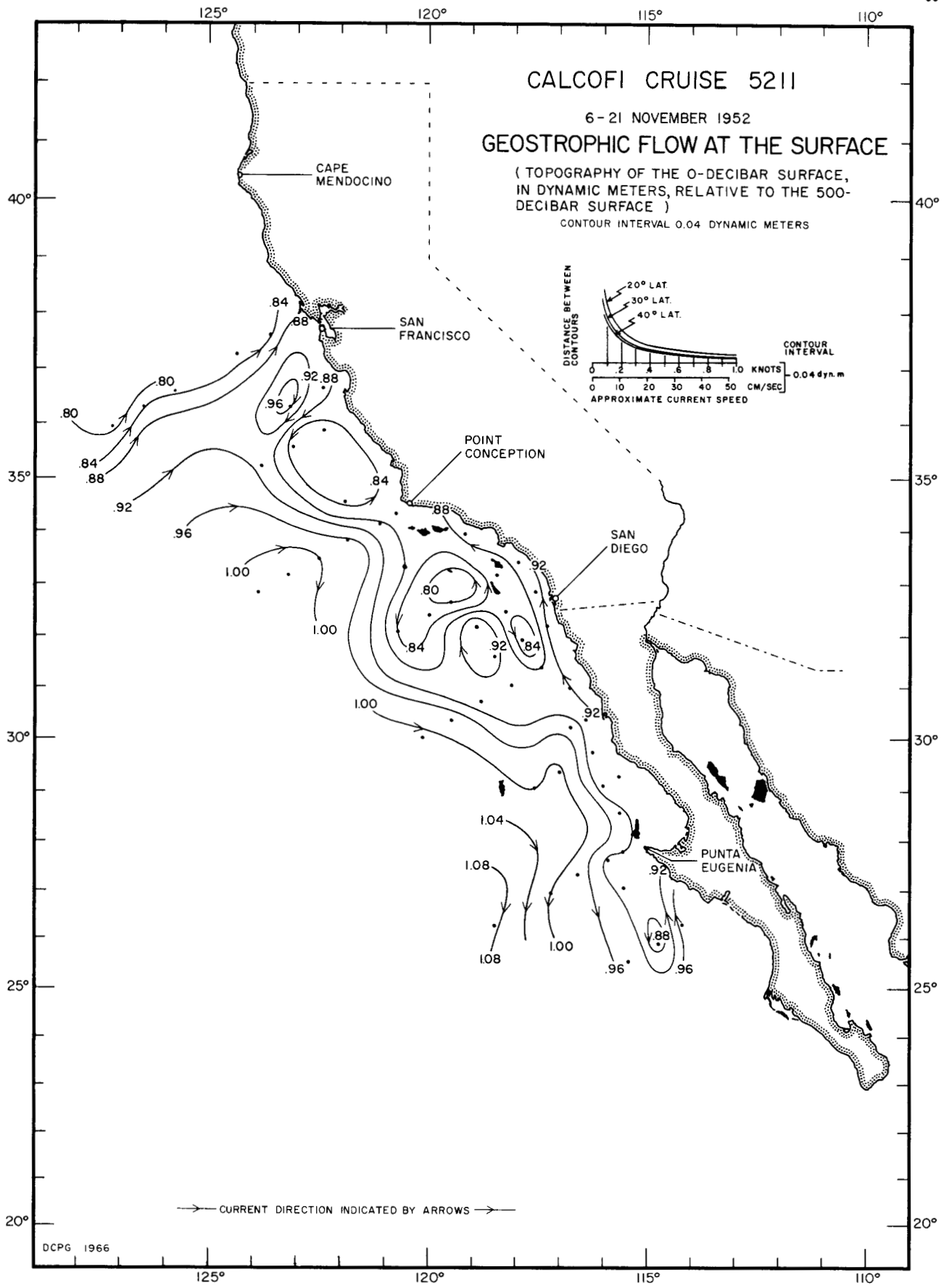


0/500 db  
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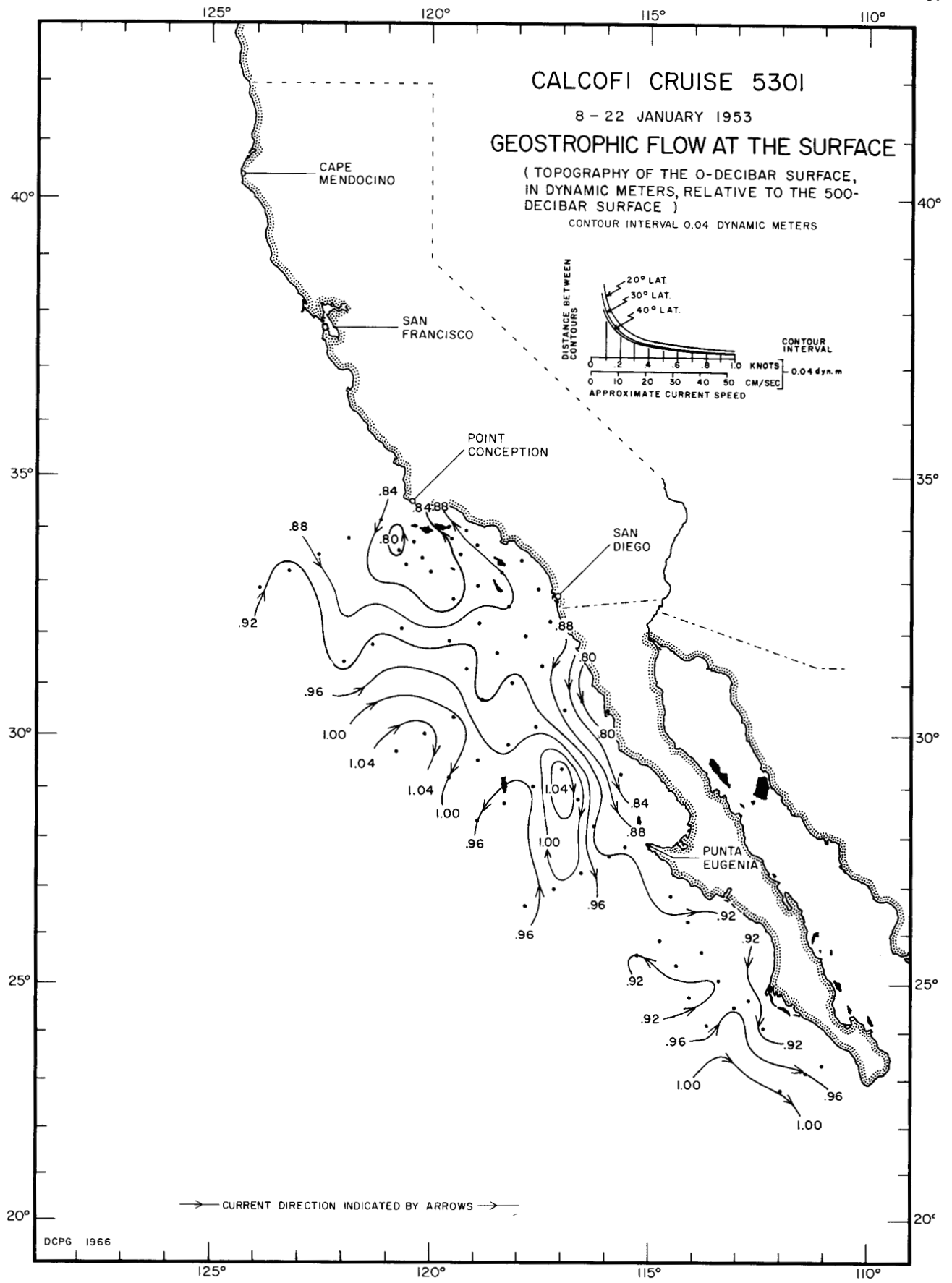




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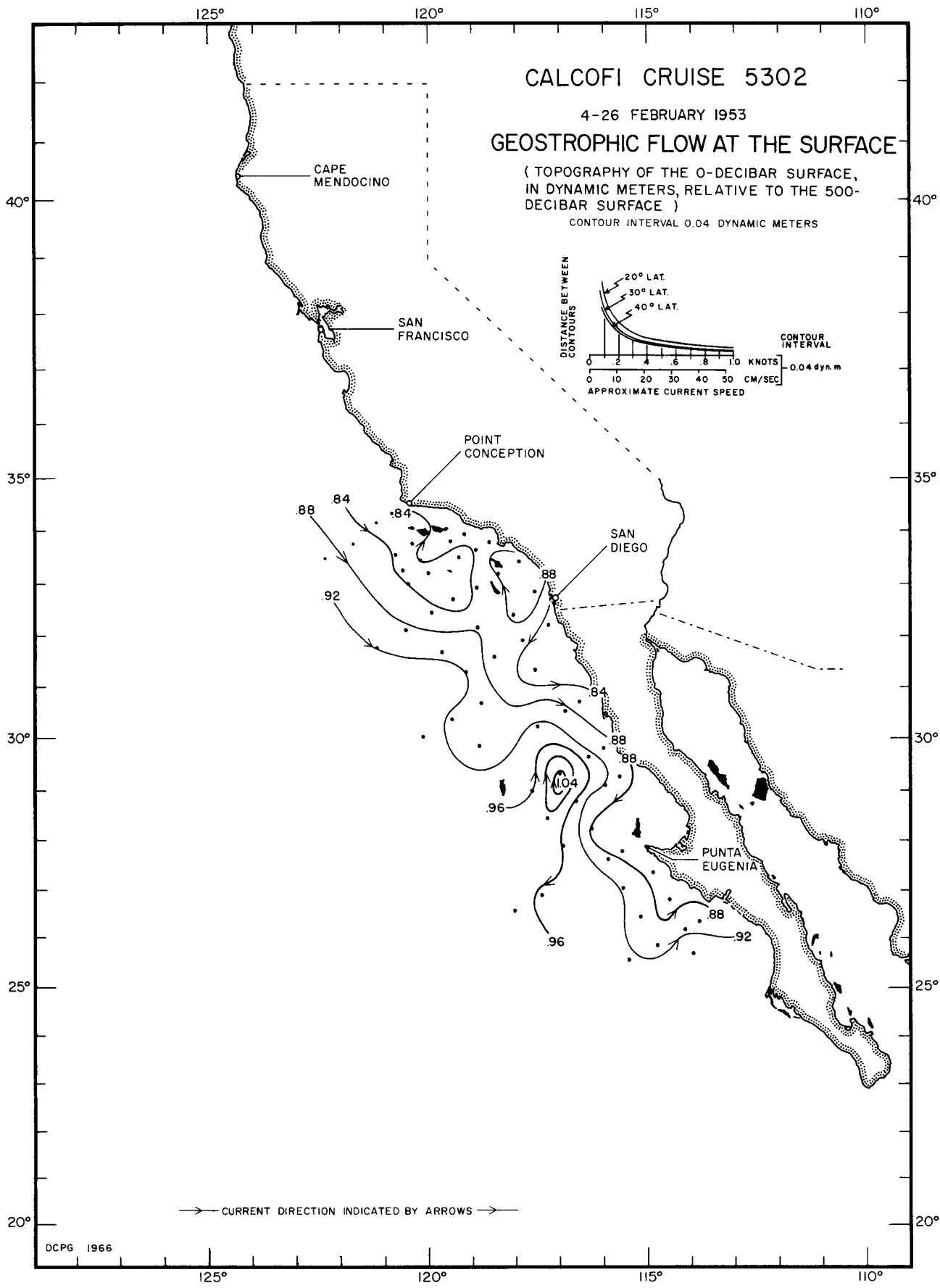


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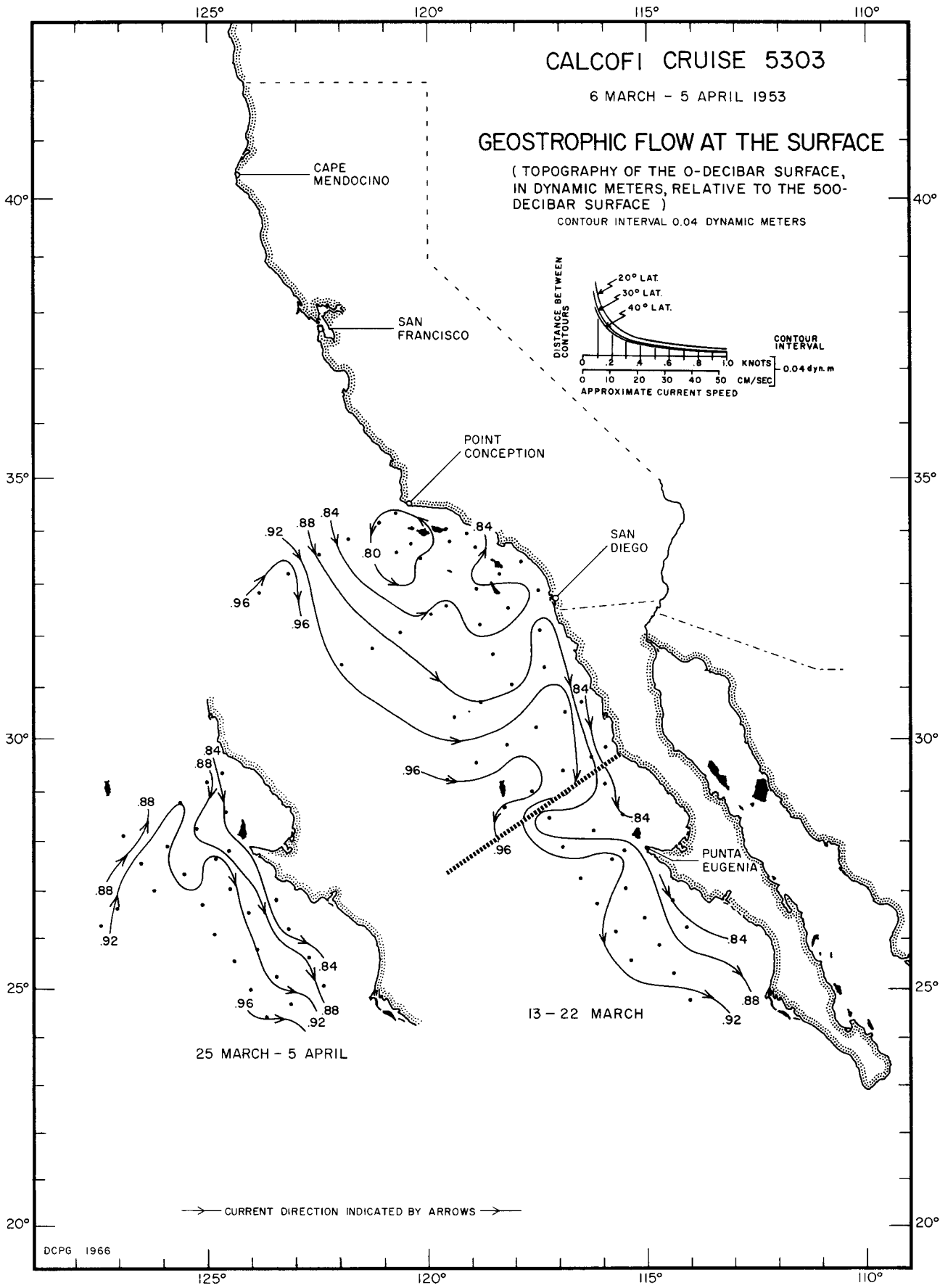
DCPG 1966

O/500 db  
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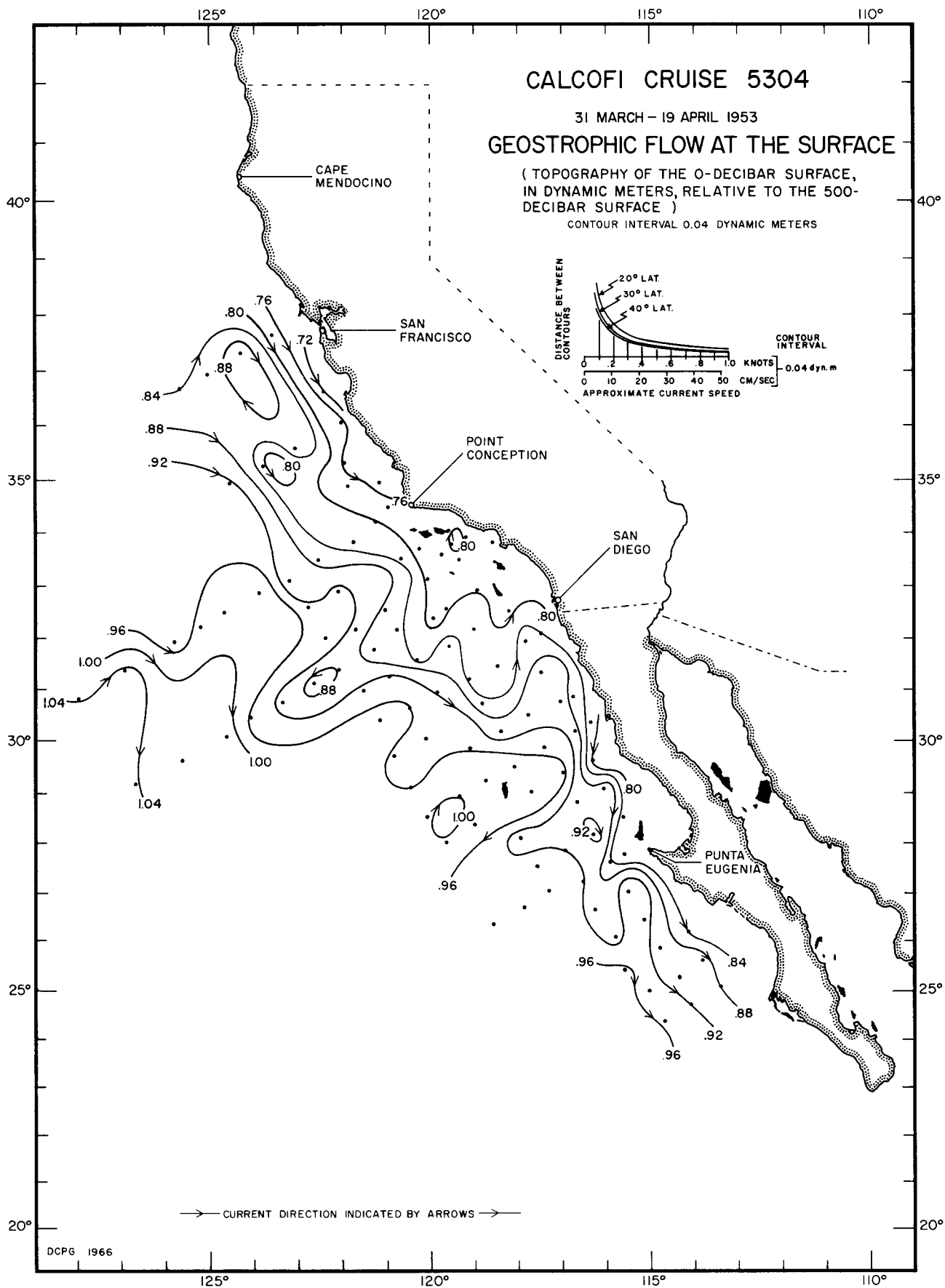


DCPG 1966

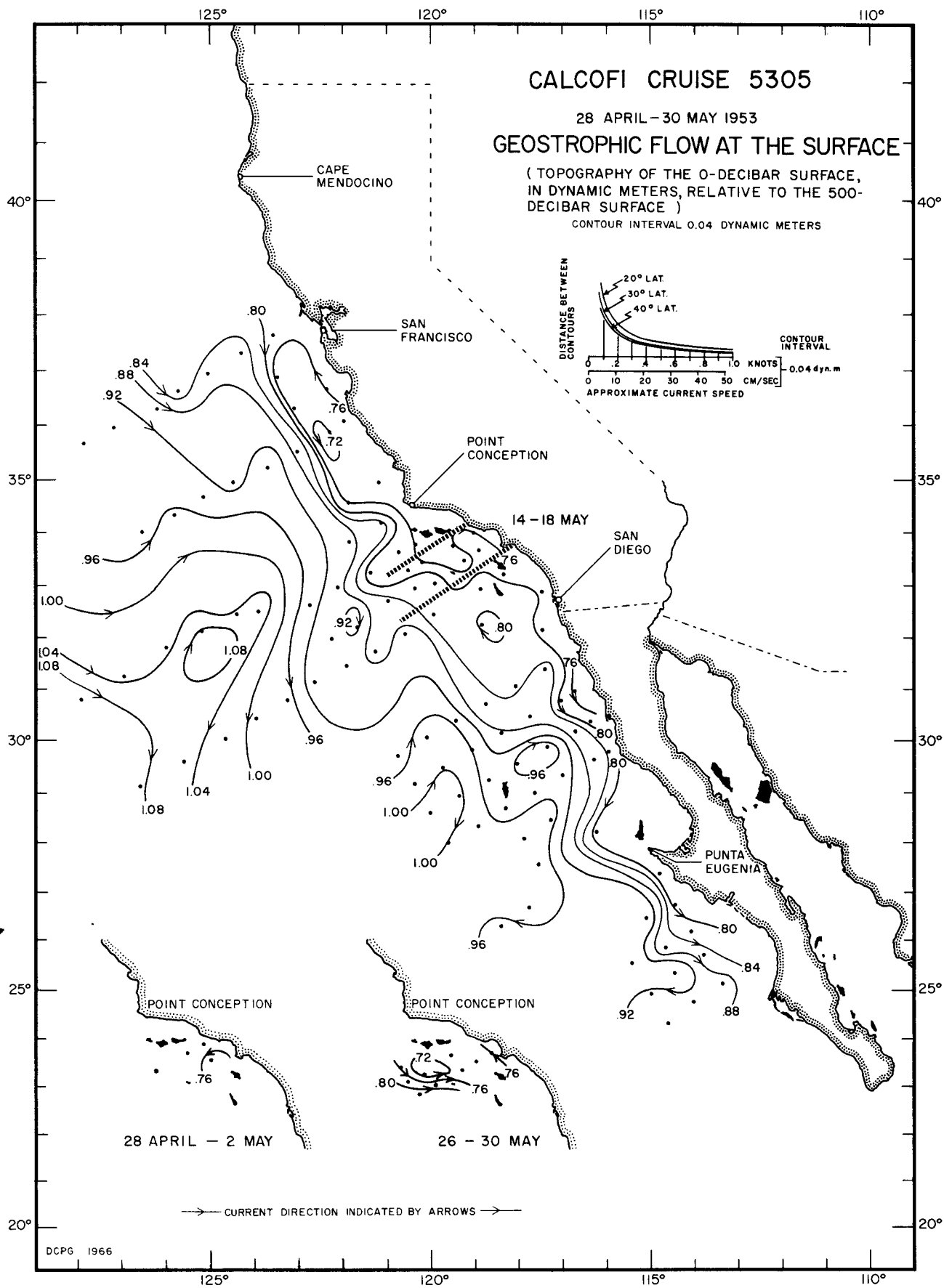
O/500 db  
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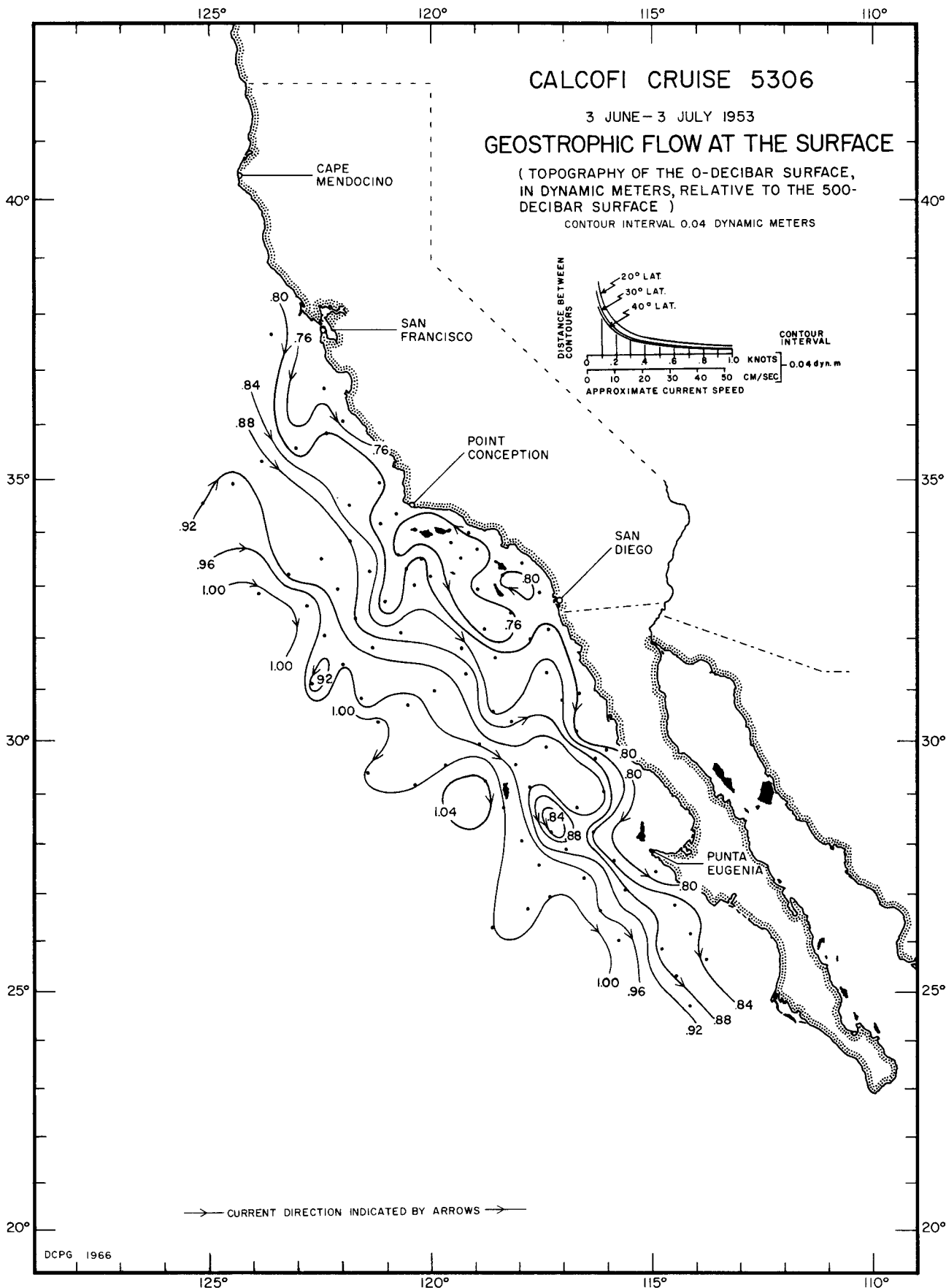
DCPG 1966



0/500 db  
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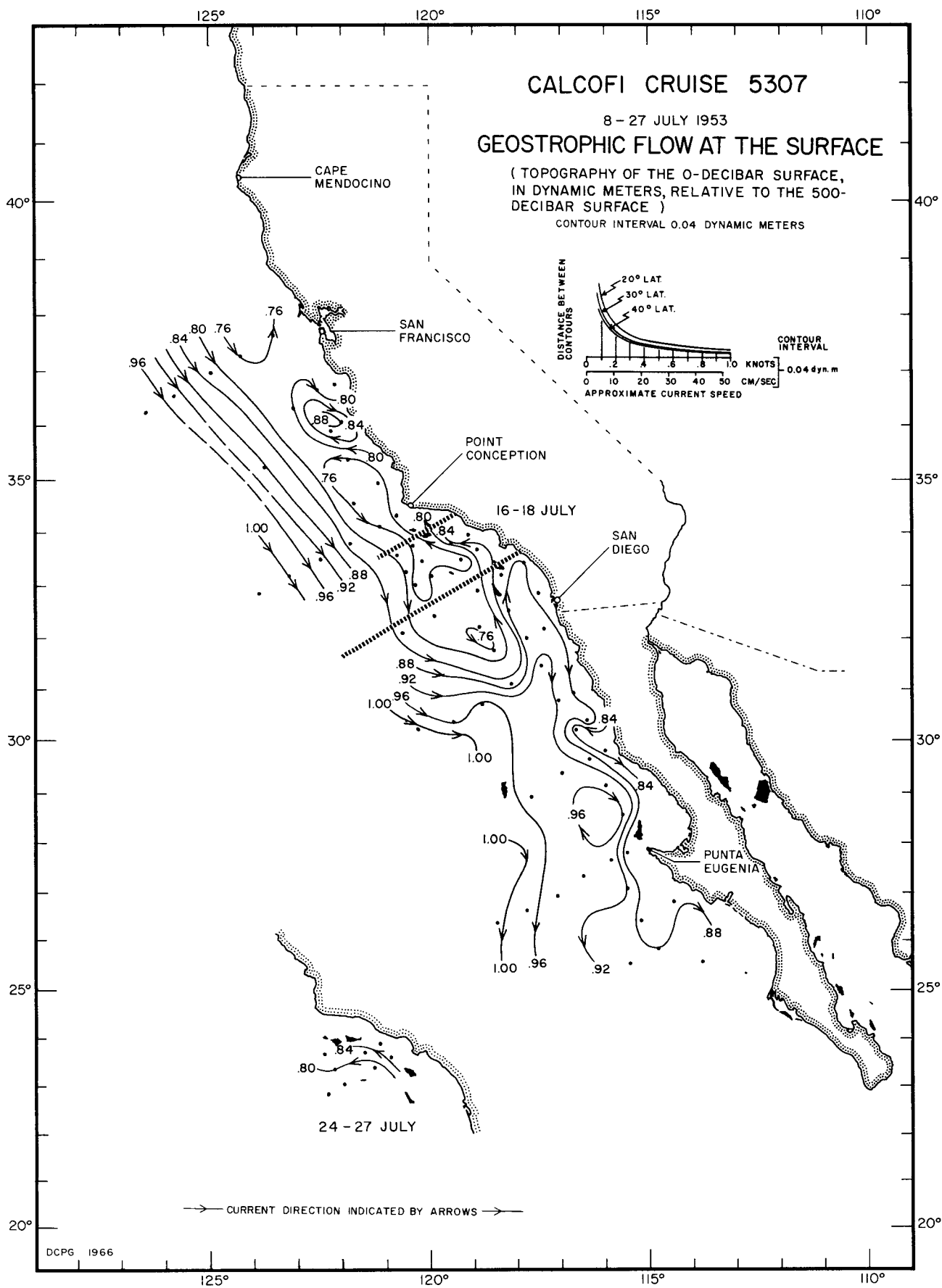


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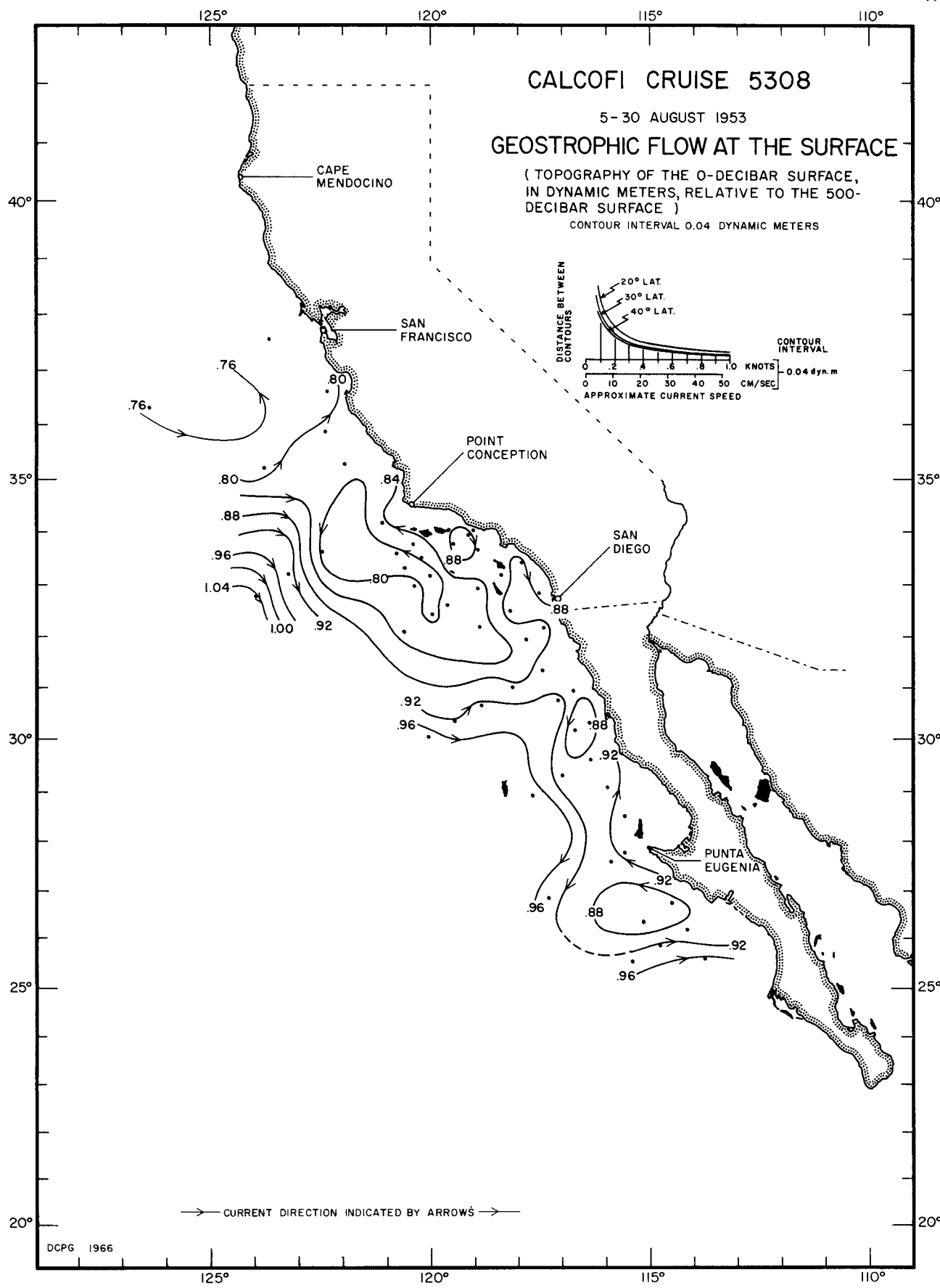


O/500 db  
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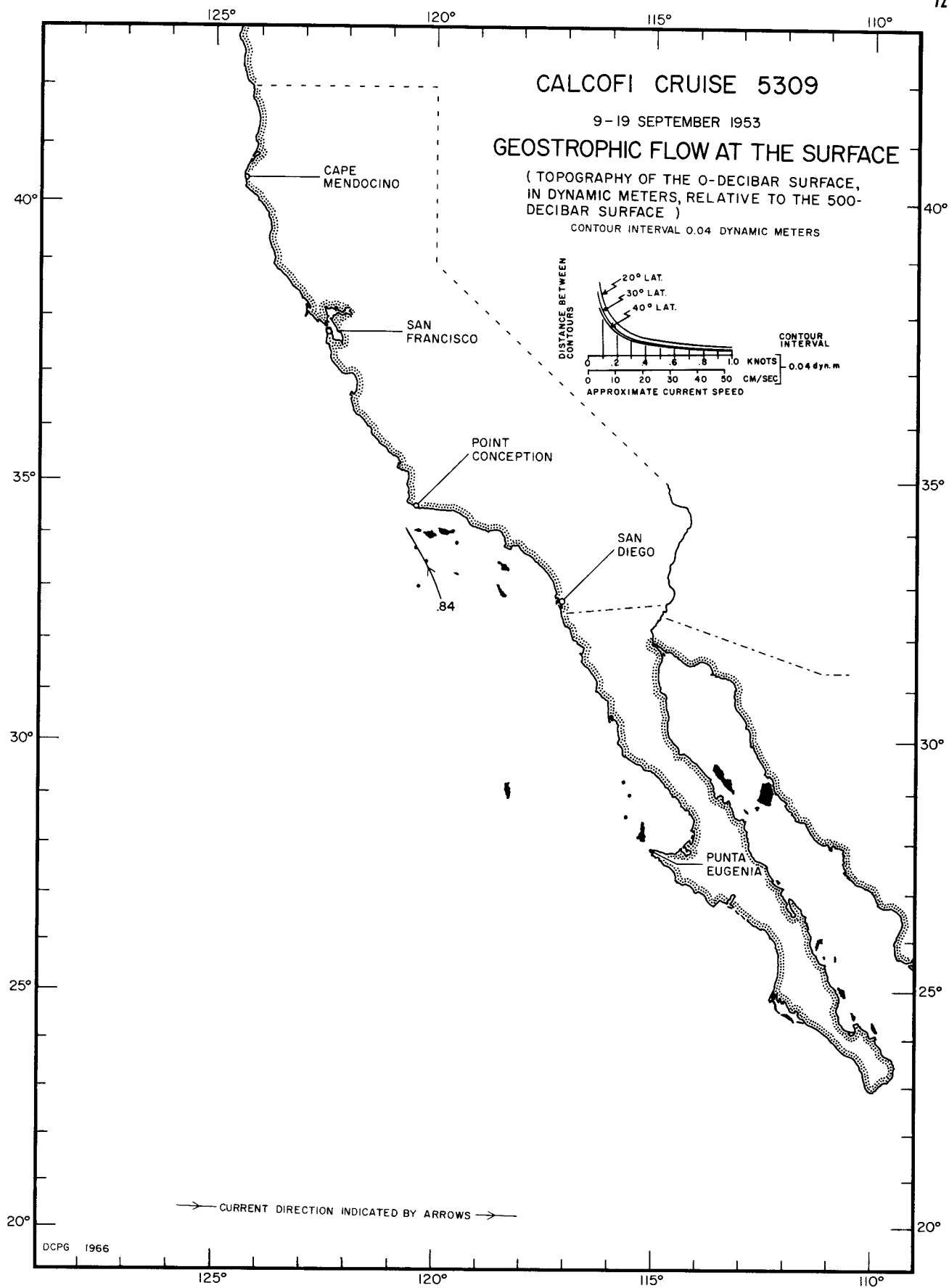


O/500 db  
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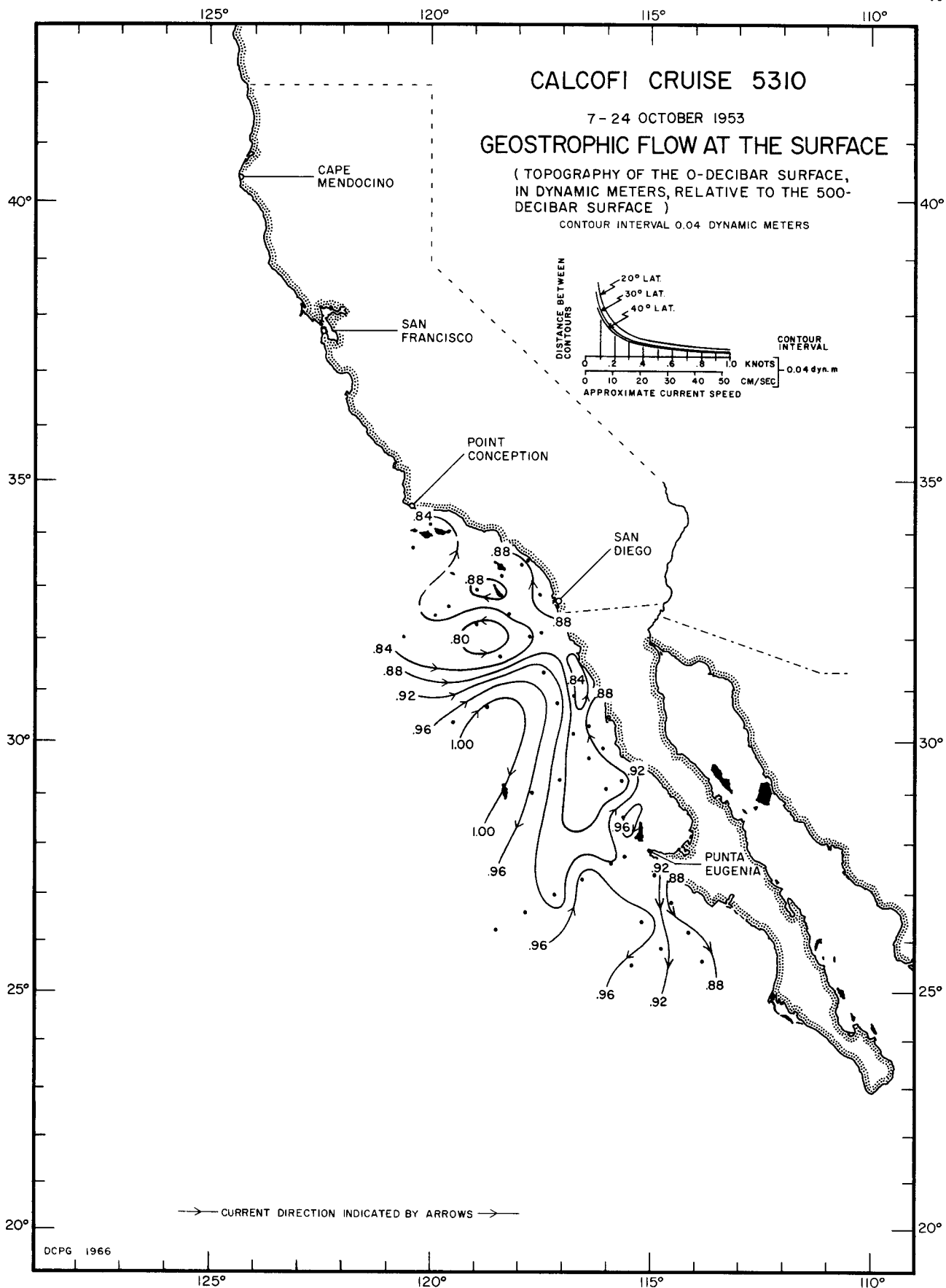


DCPG 1966

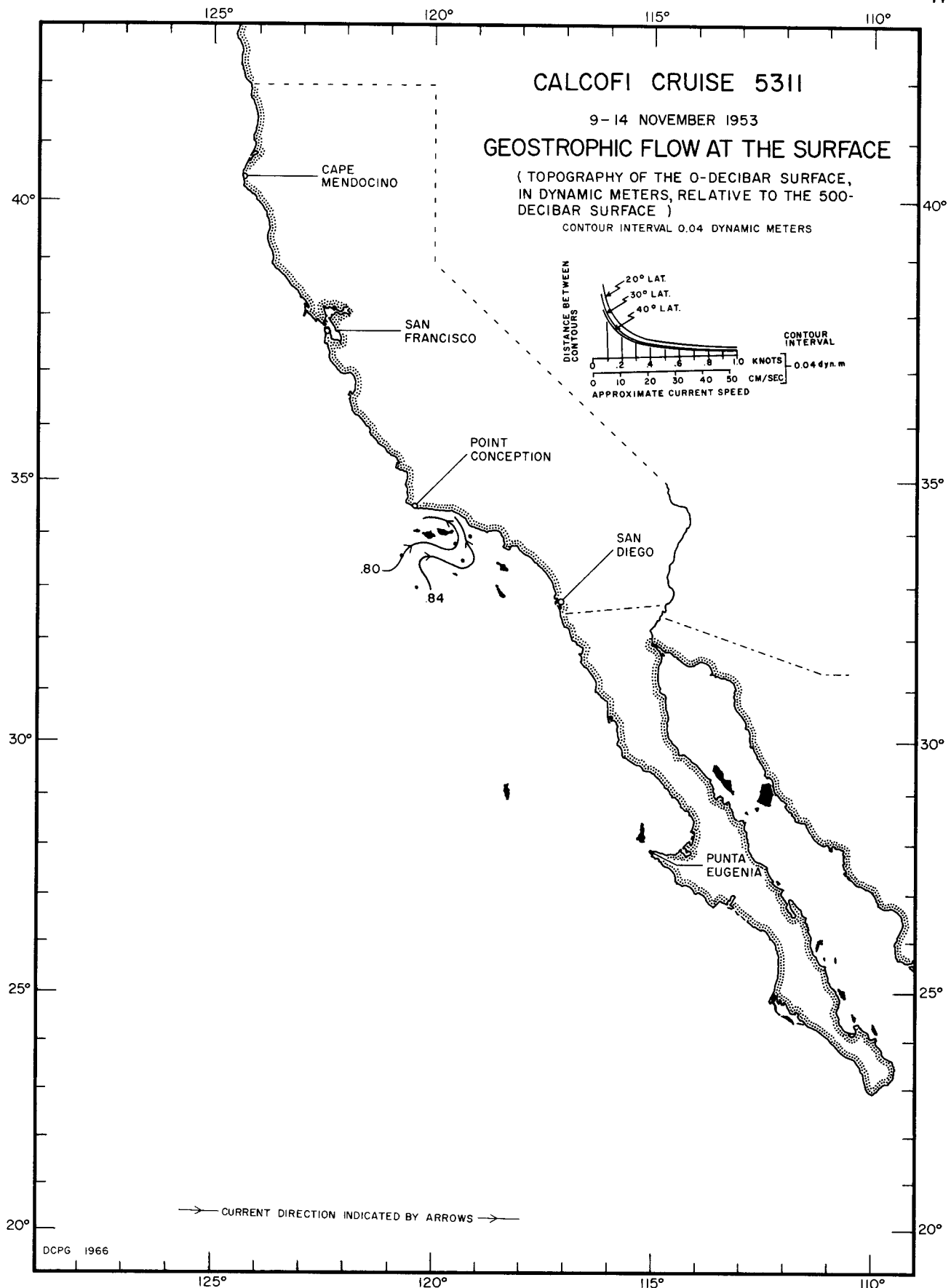
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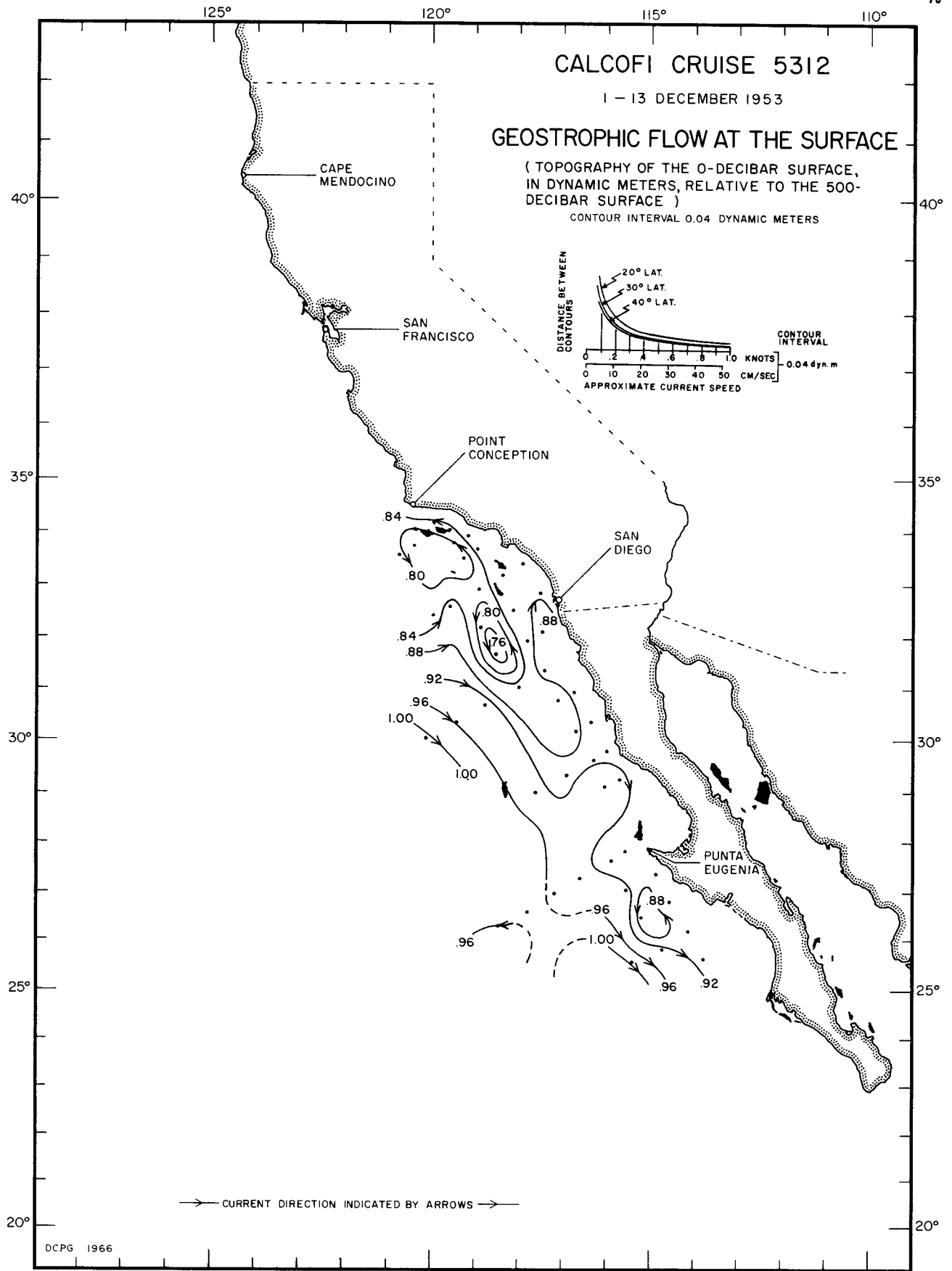
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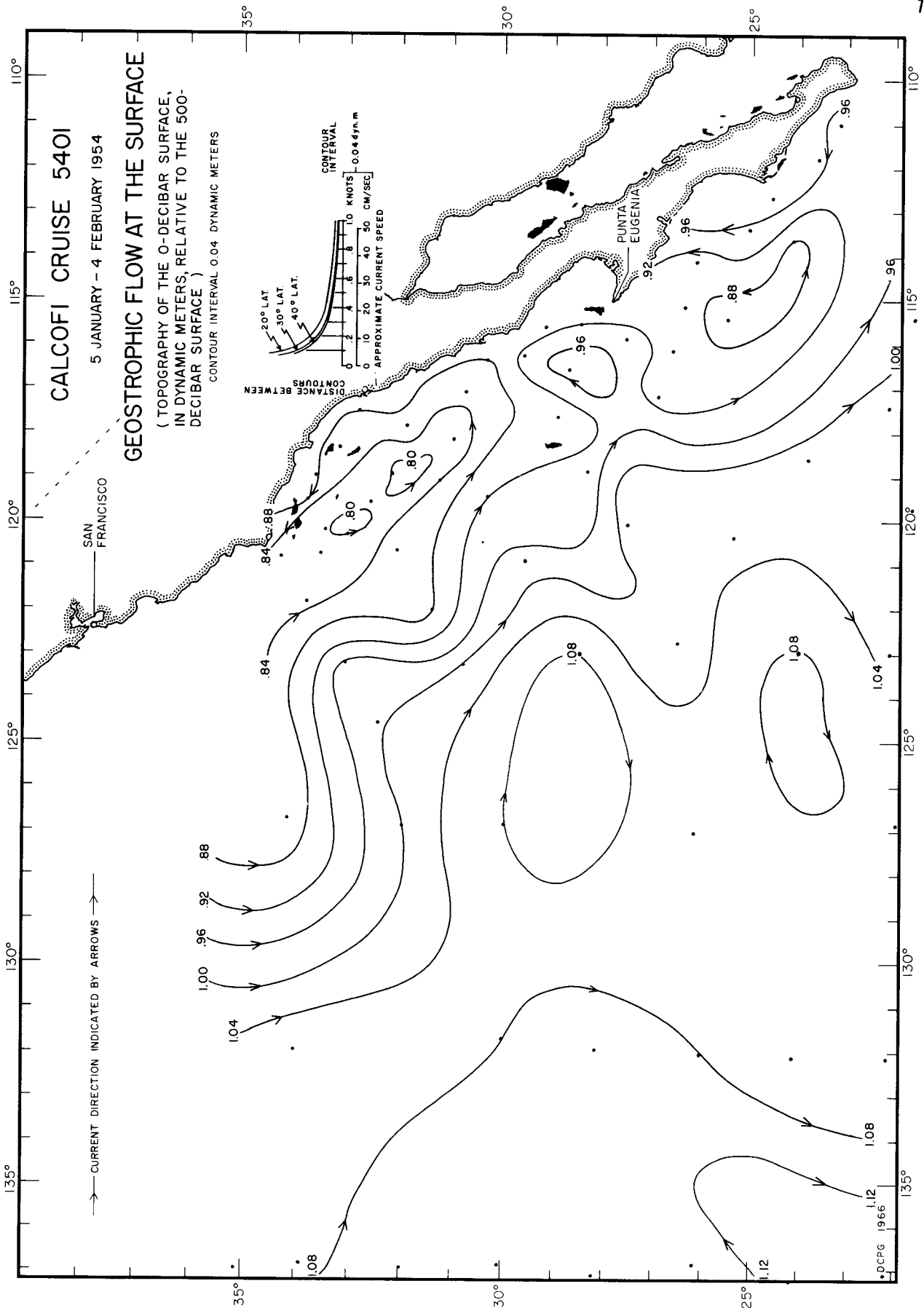
O/500 db  
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O/500 db  
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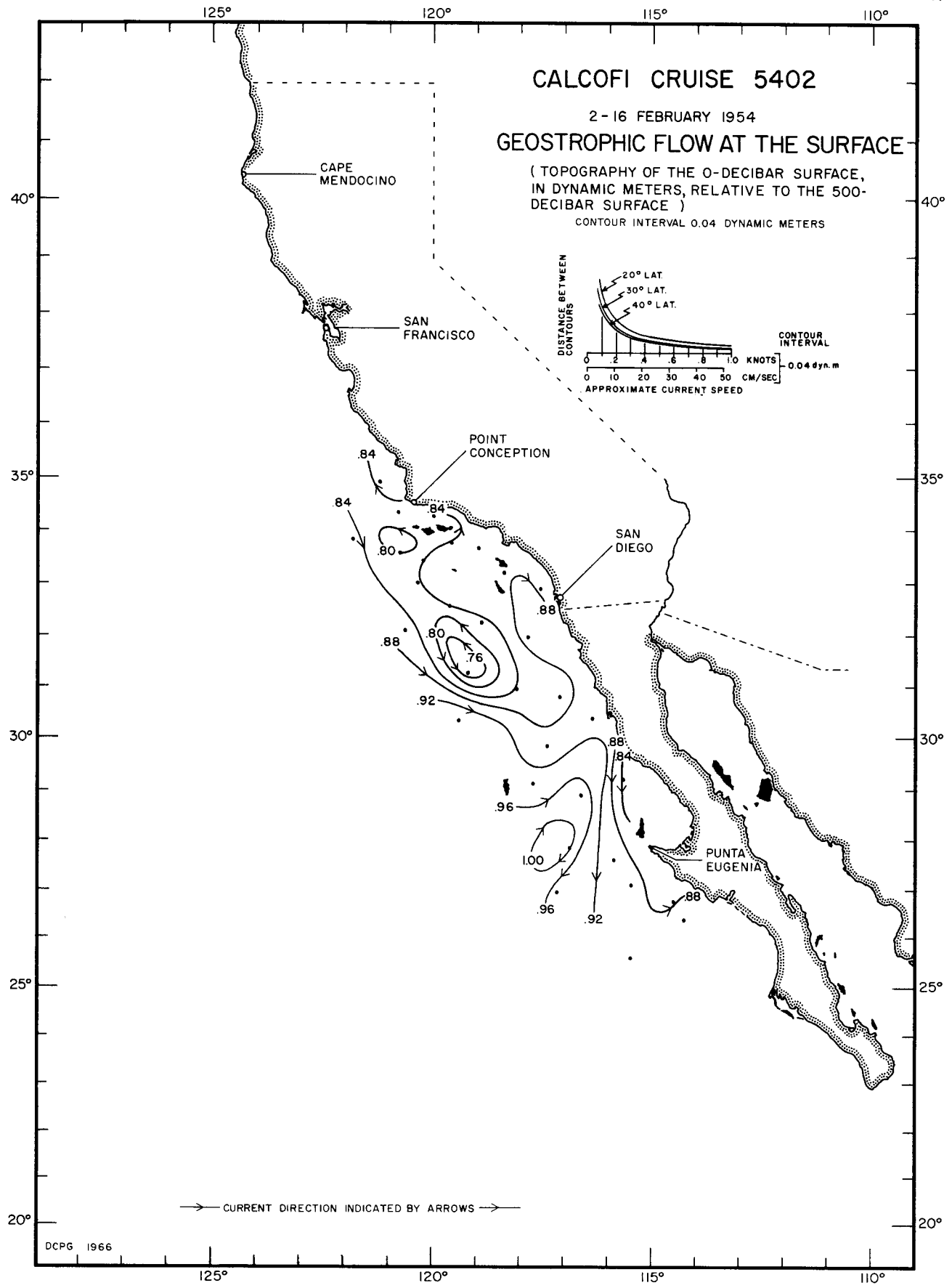


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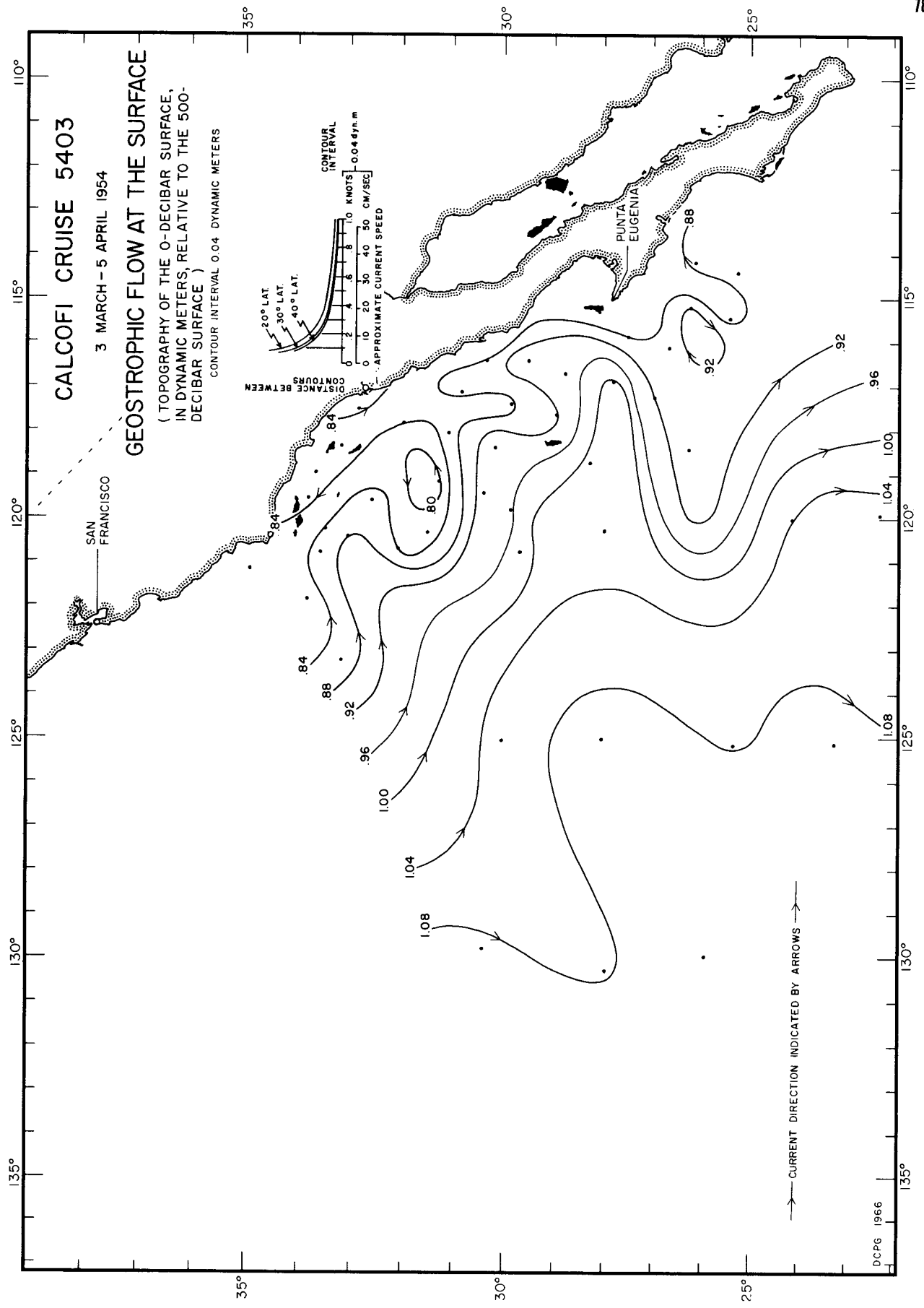
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•DCFG 1966

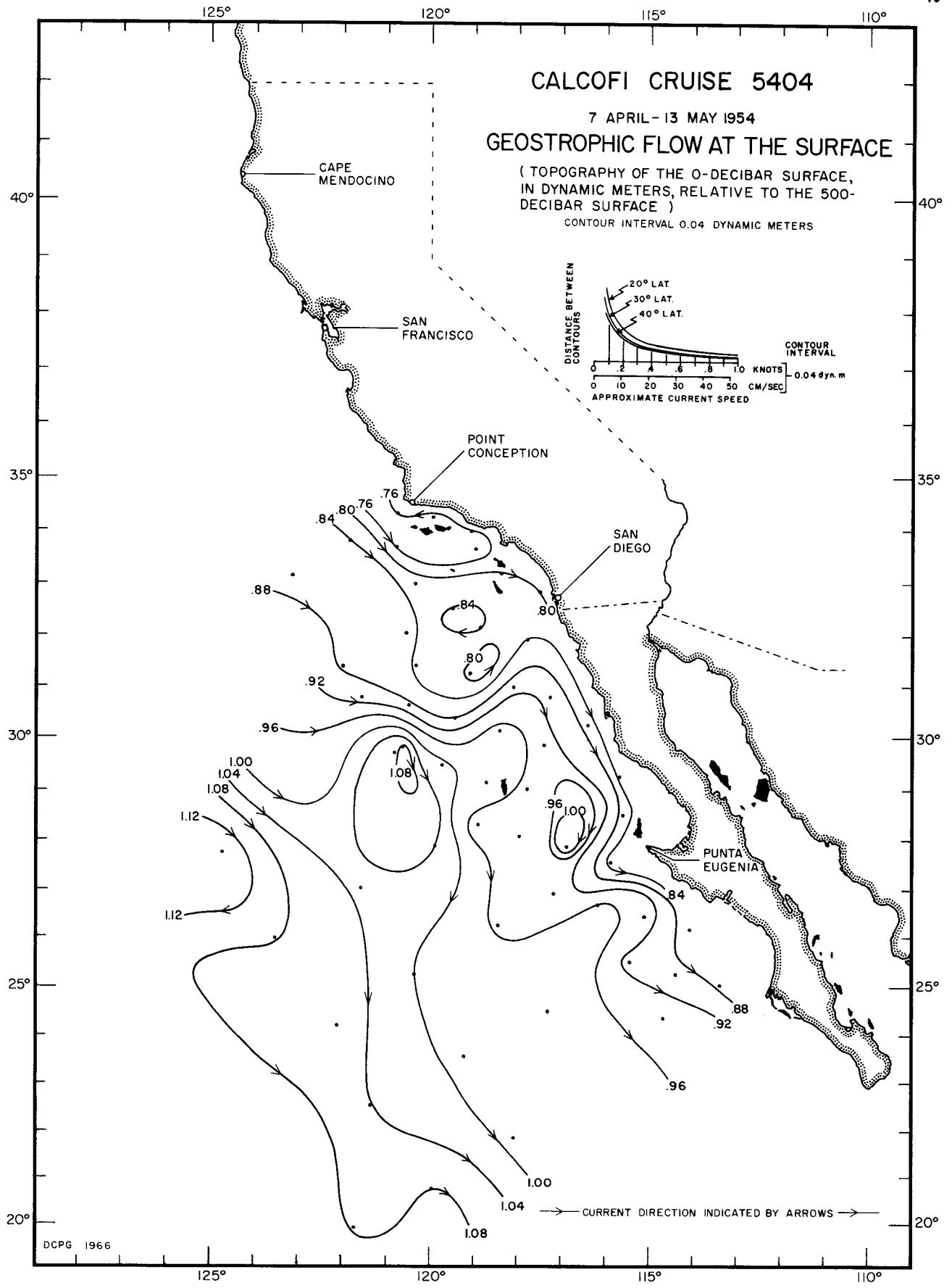


DCPG 1966



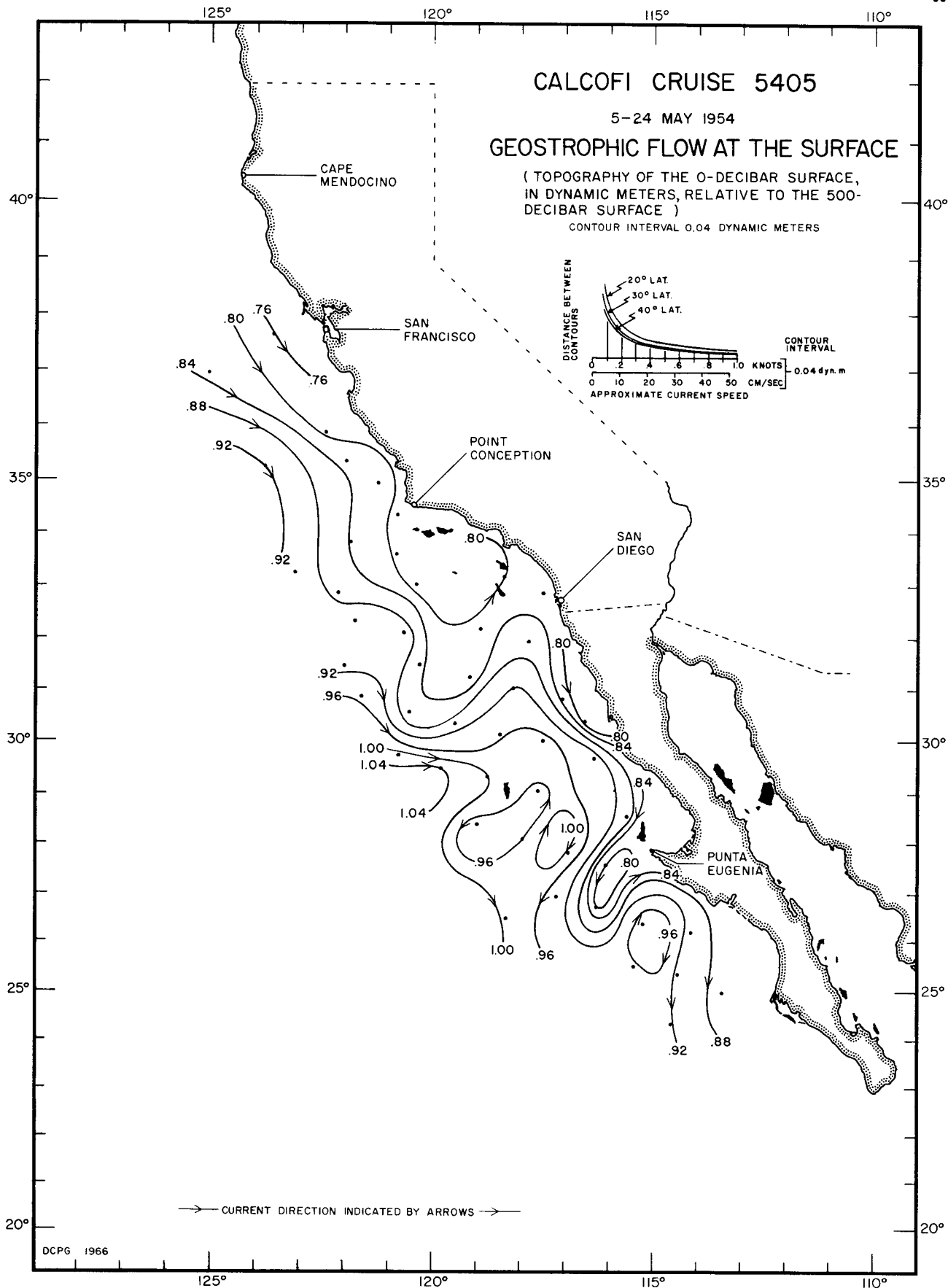


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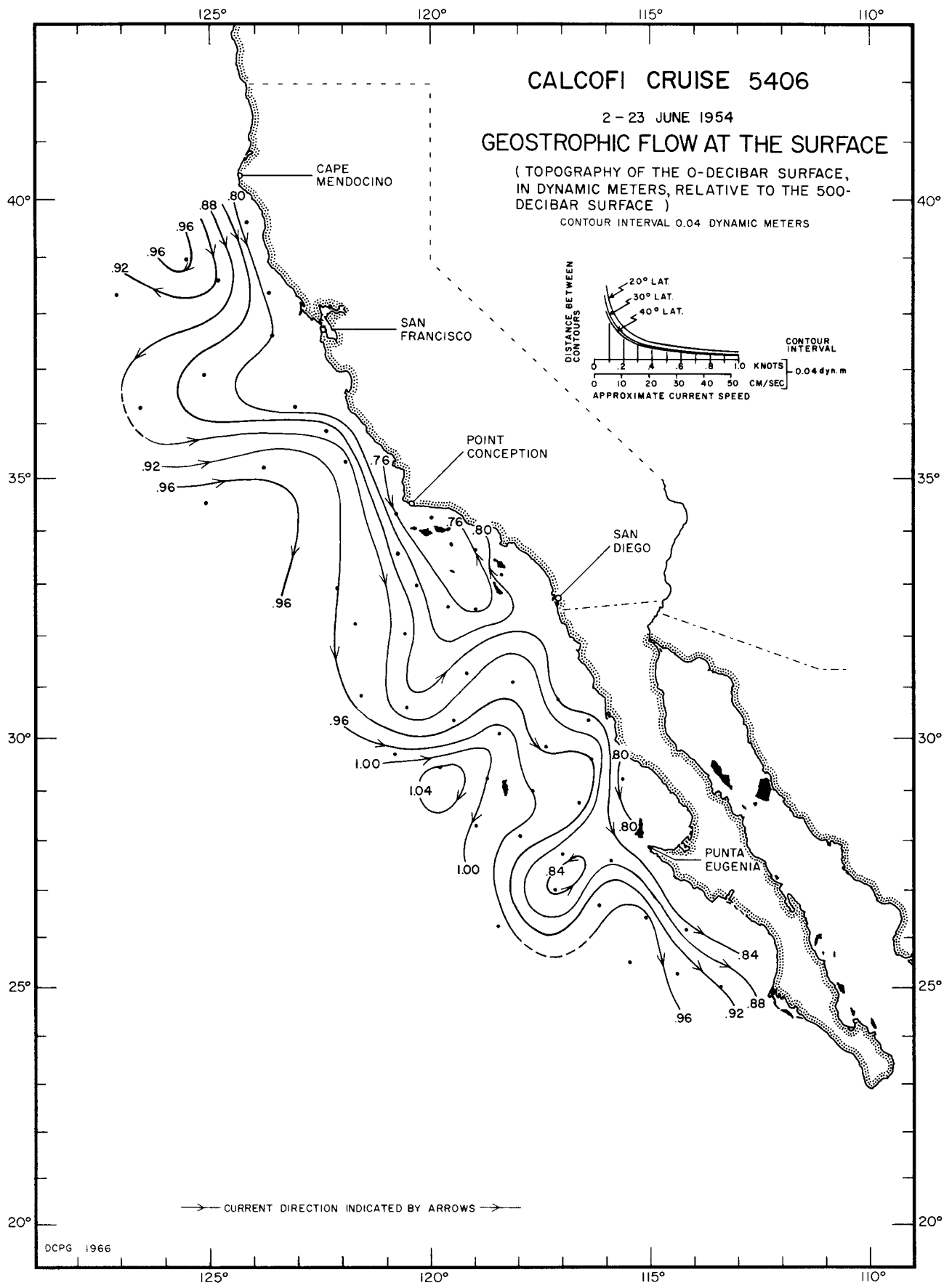
DCPG 1966

O/500 db  
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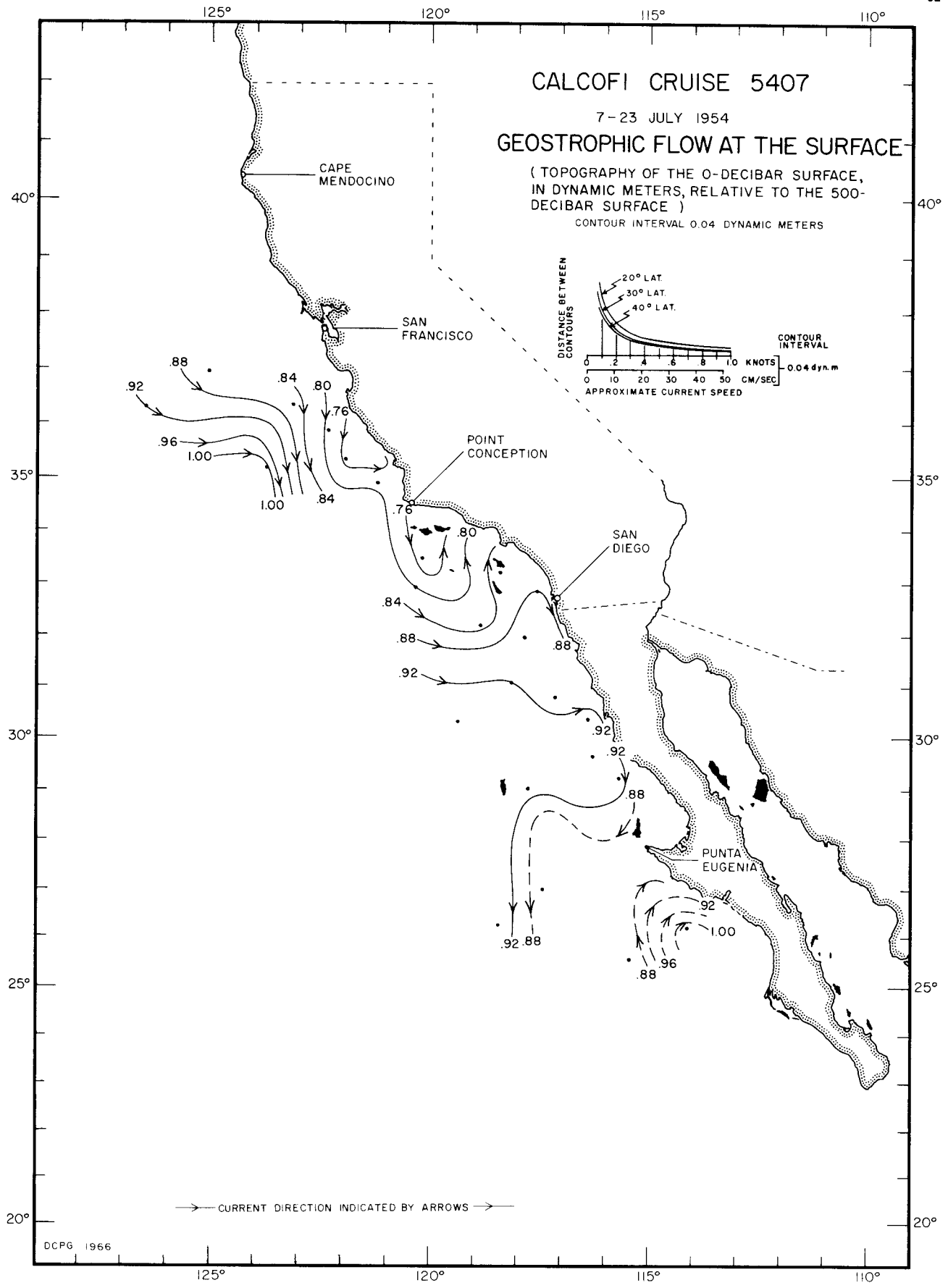
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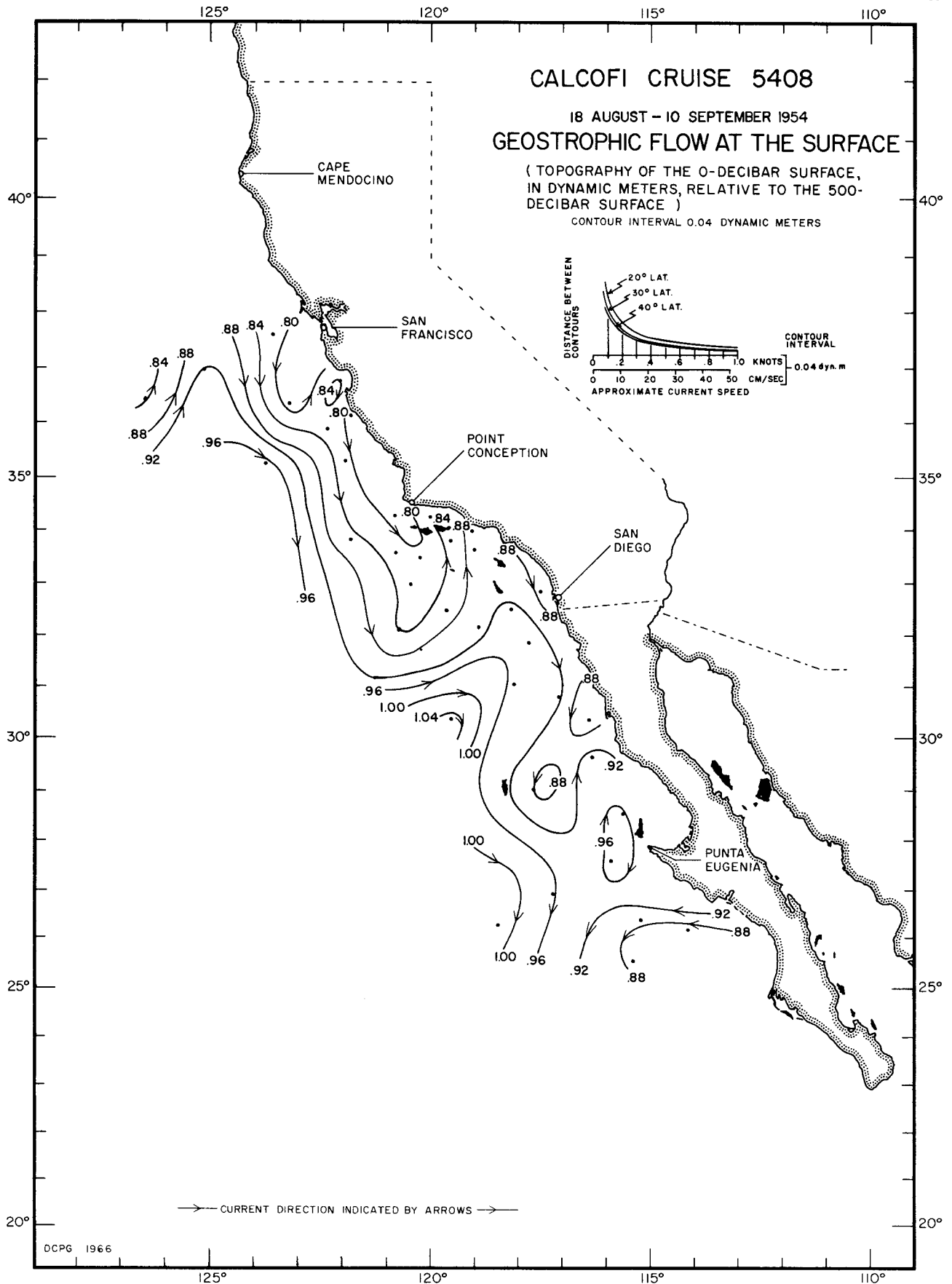
DCPG 1966

O/500 db  
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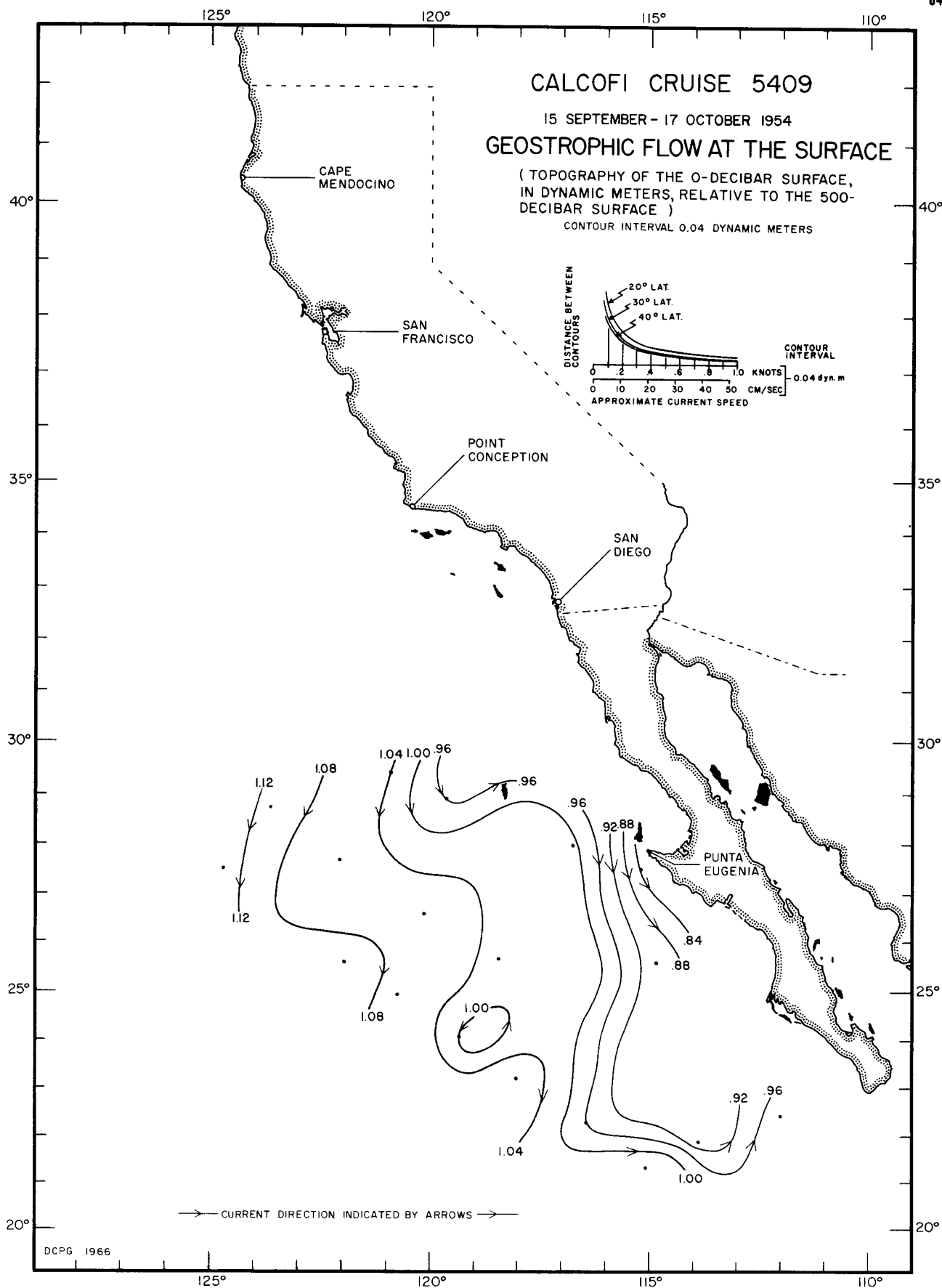


DCPG 1966

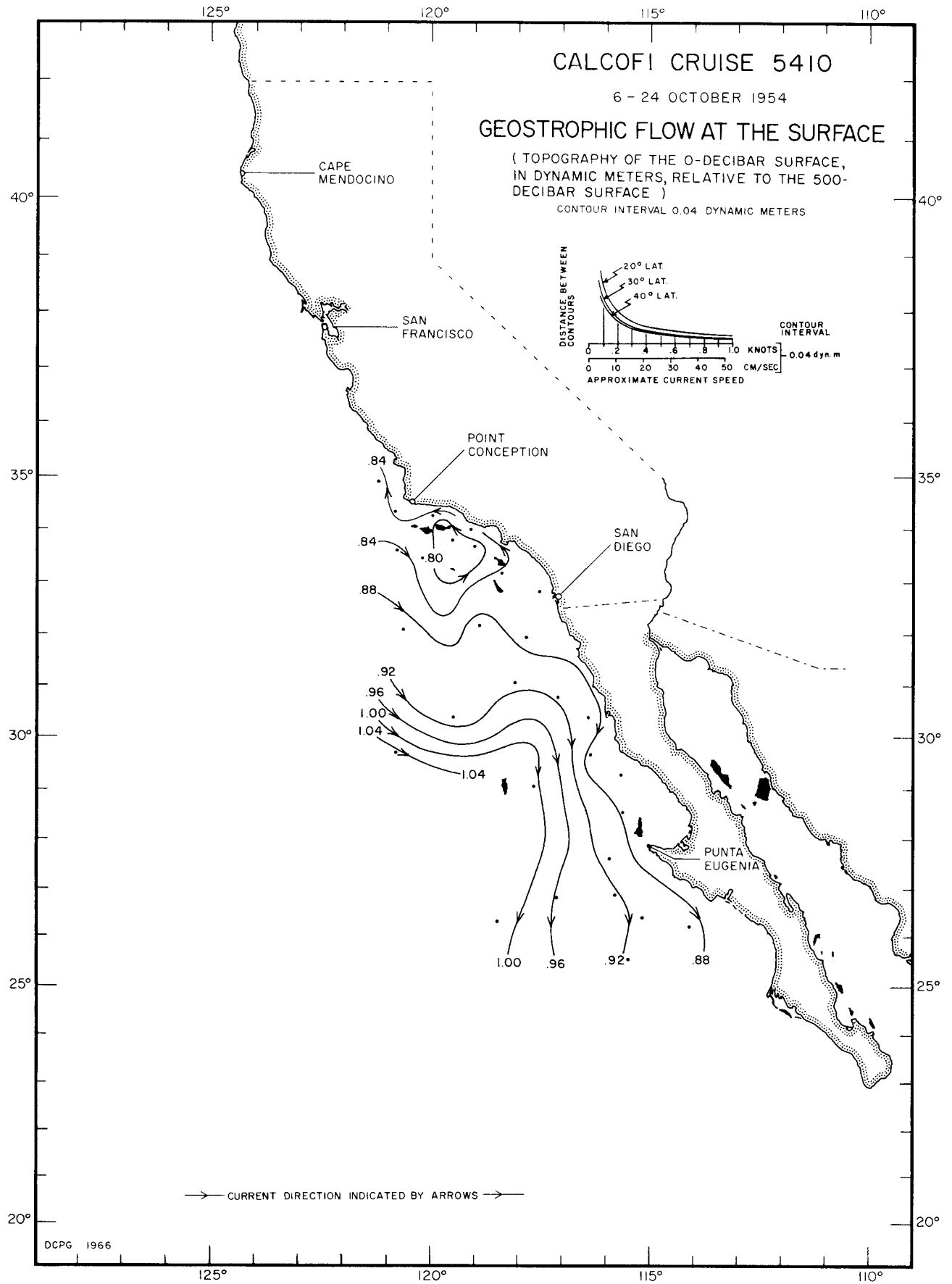
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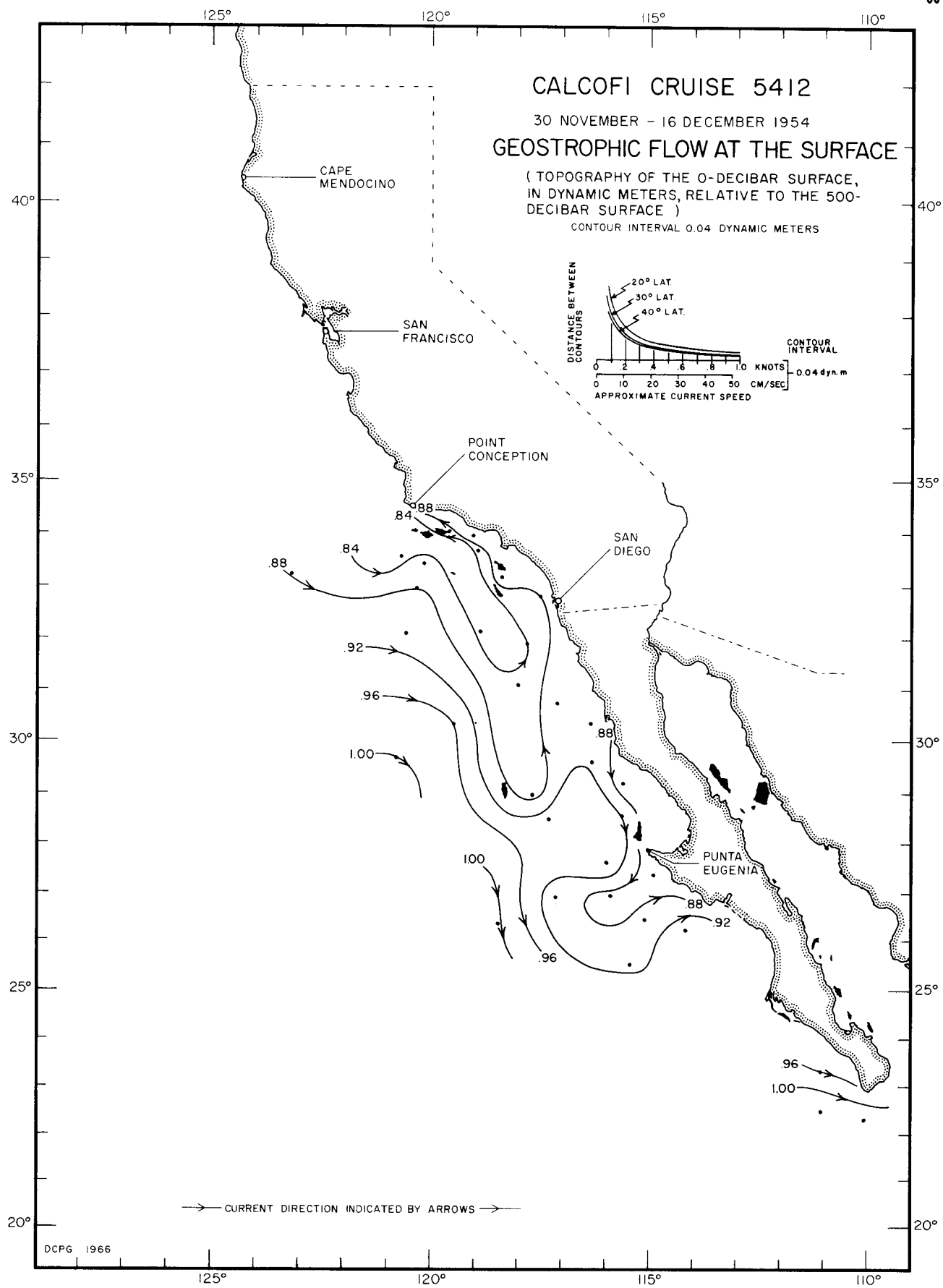
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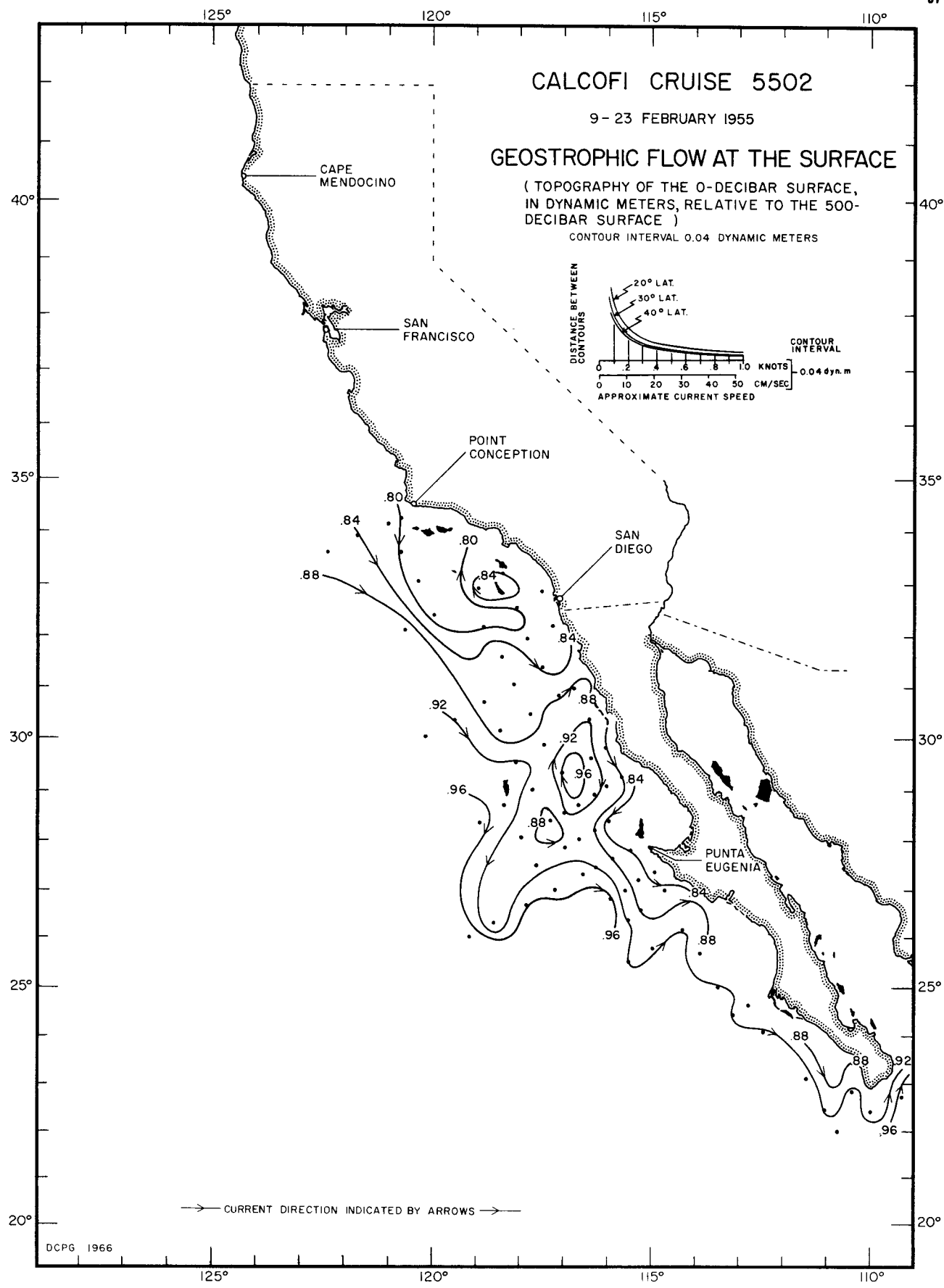
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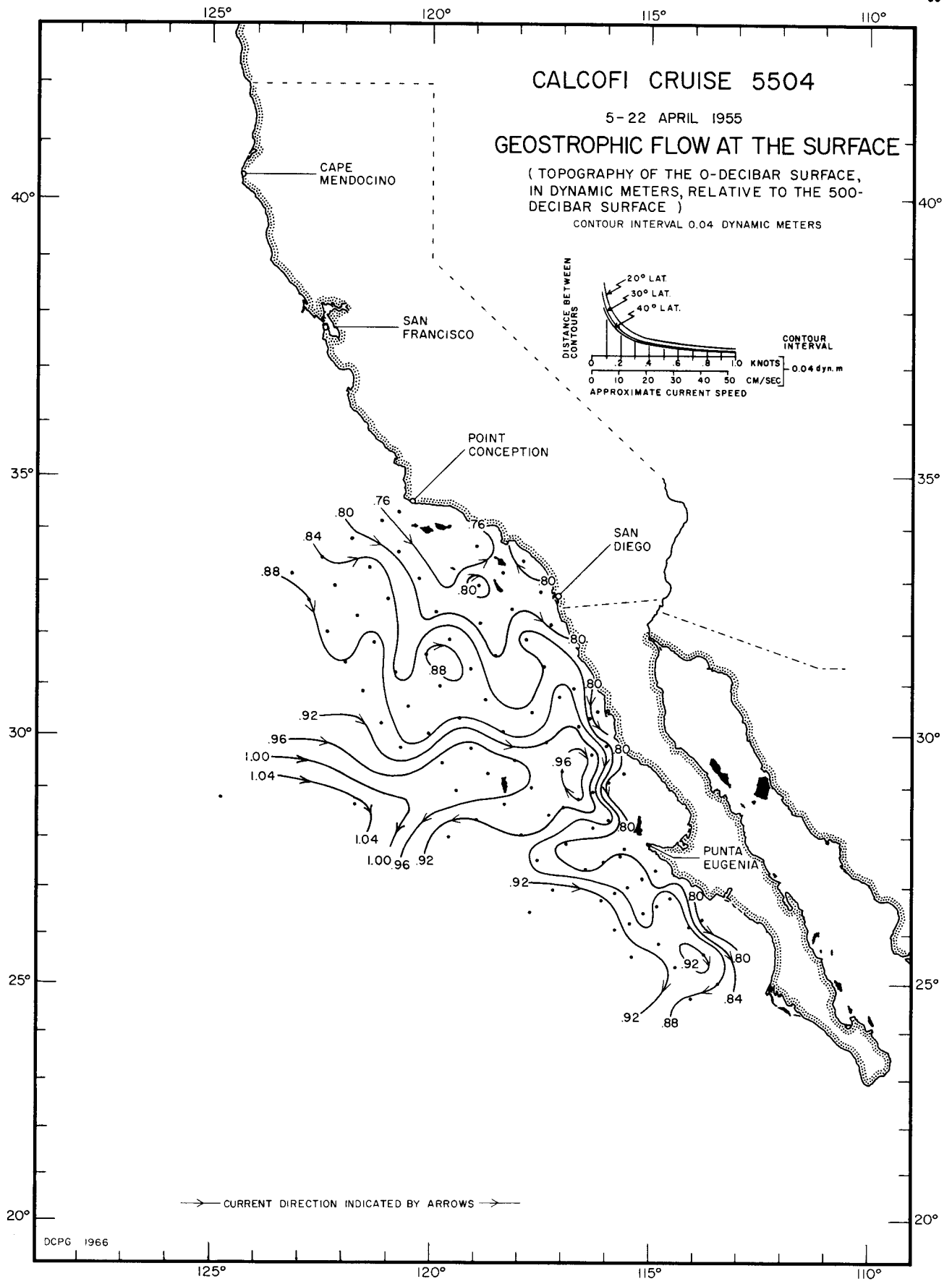




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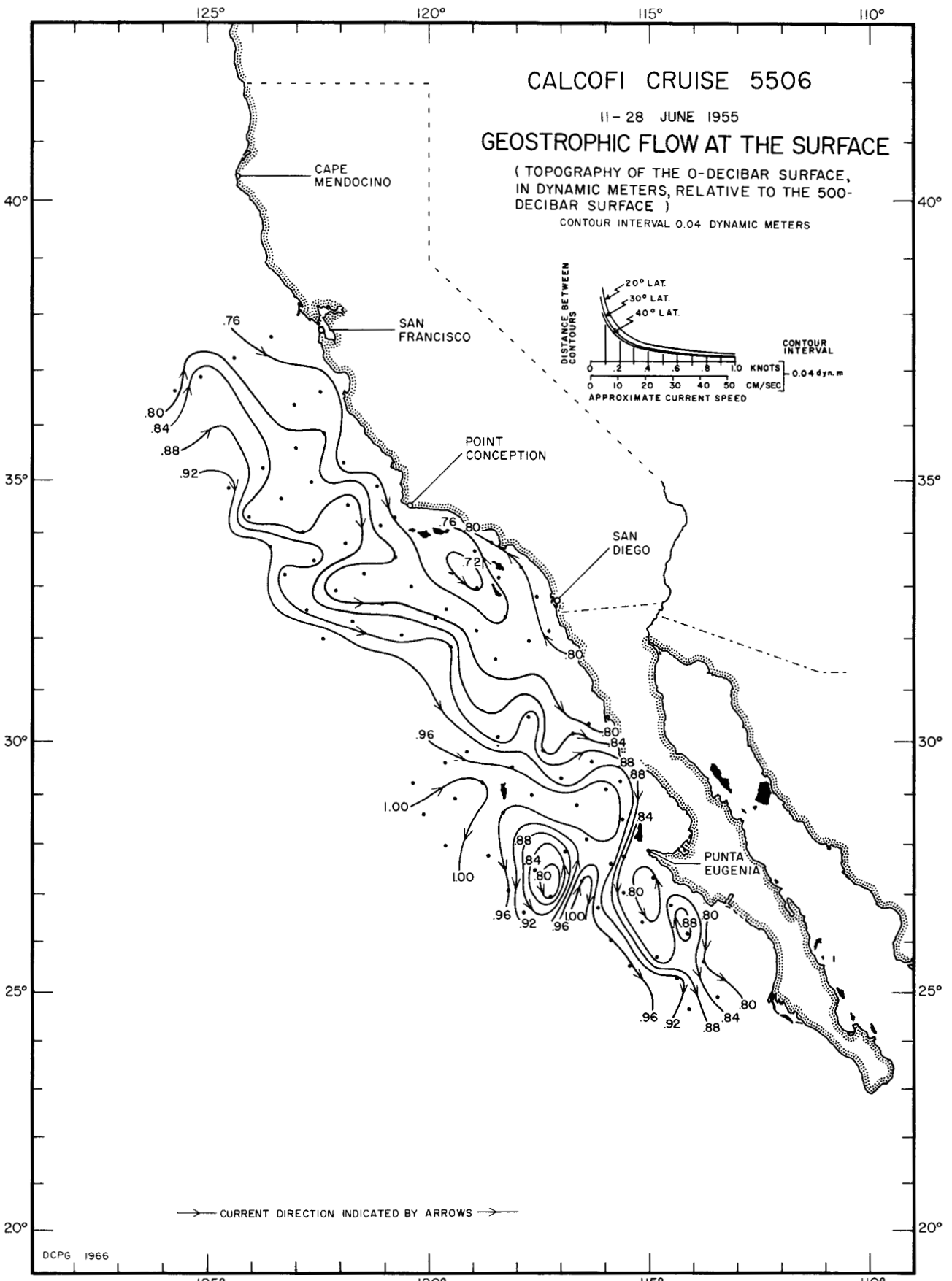


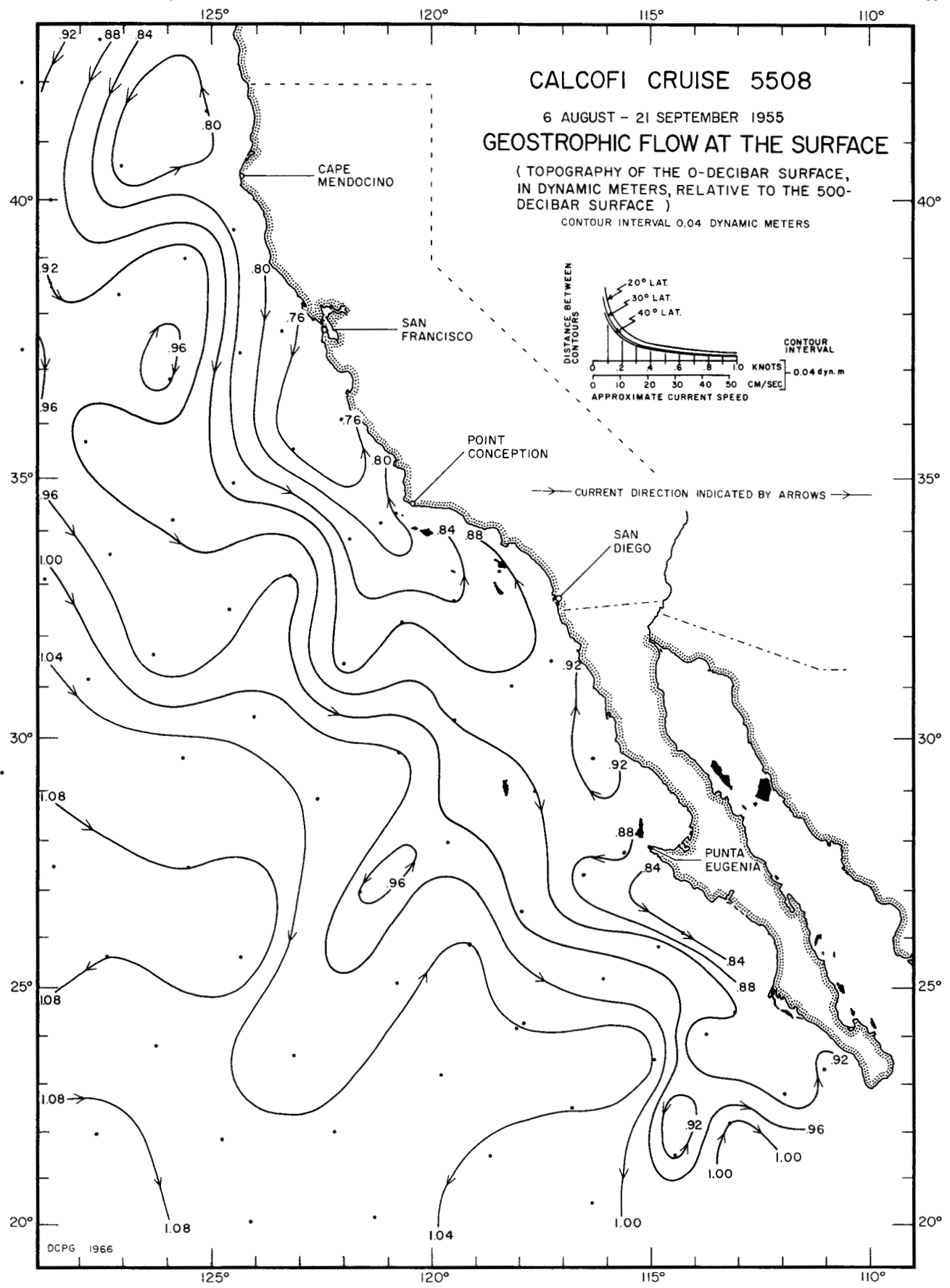
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DCPG 1966

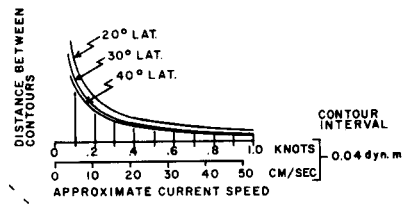
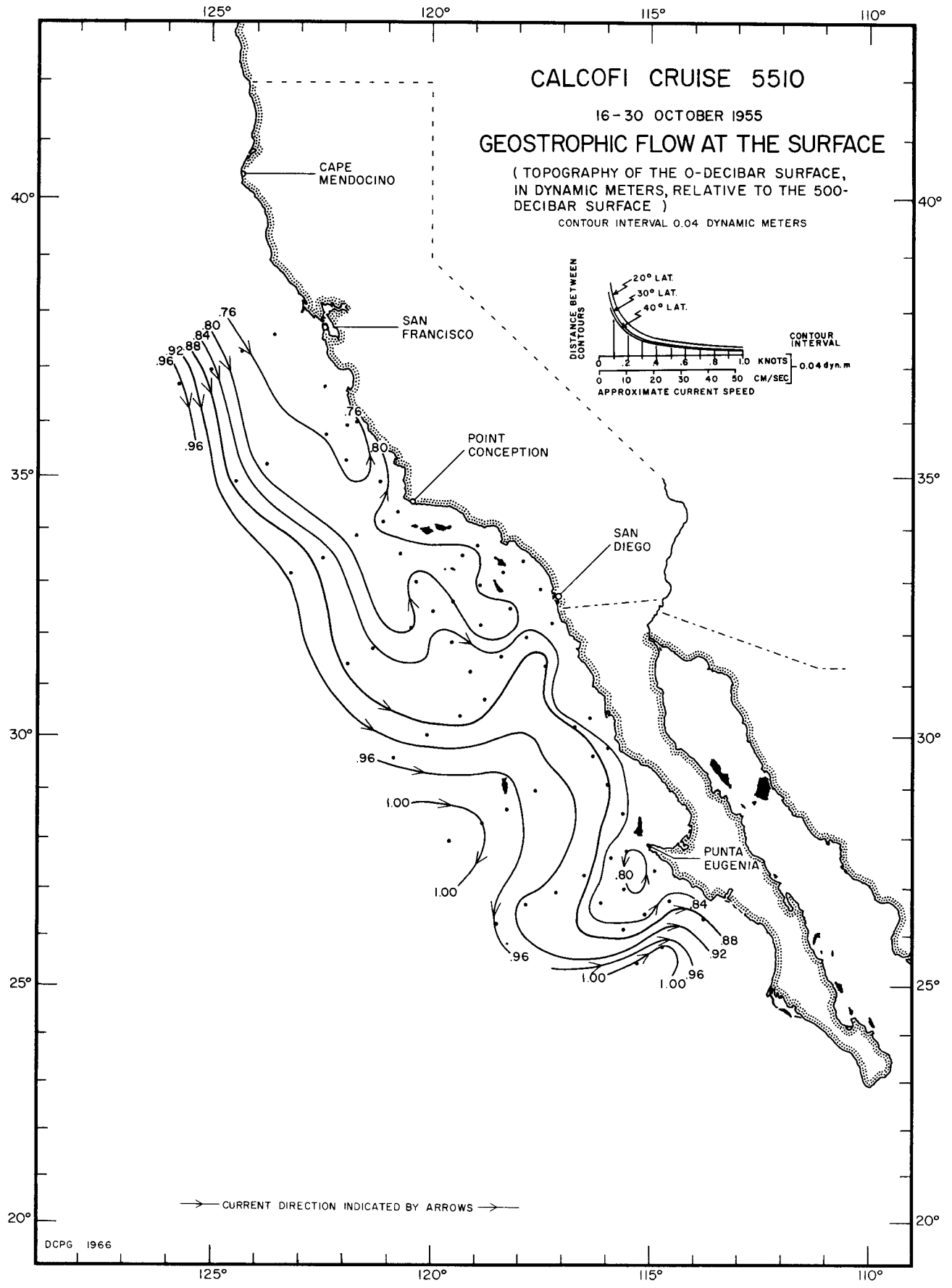
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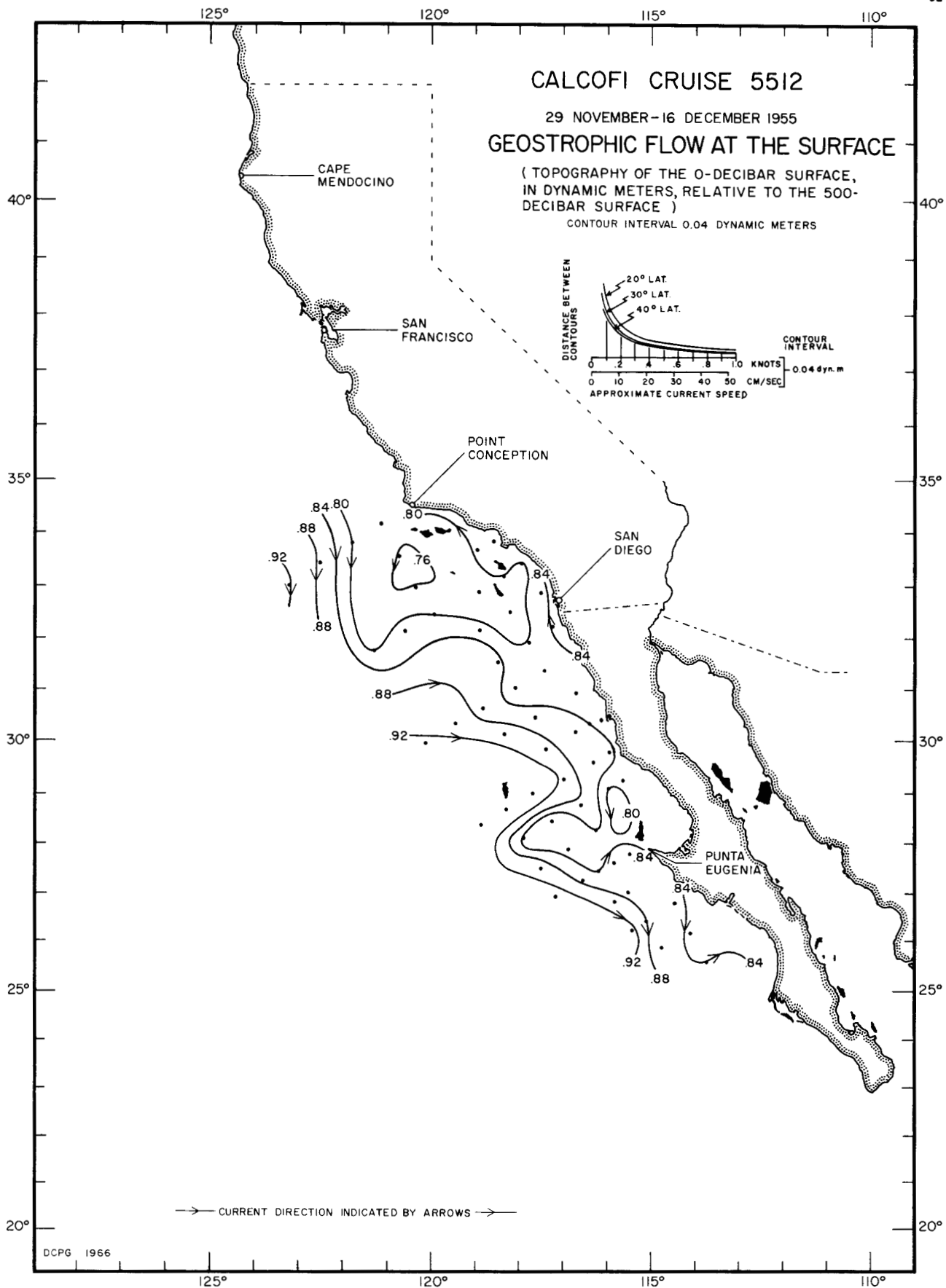


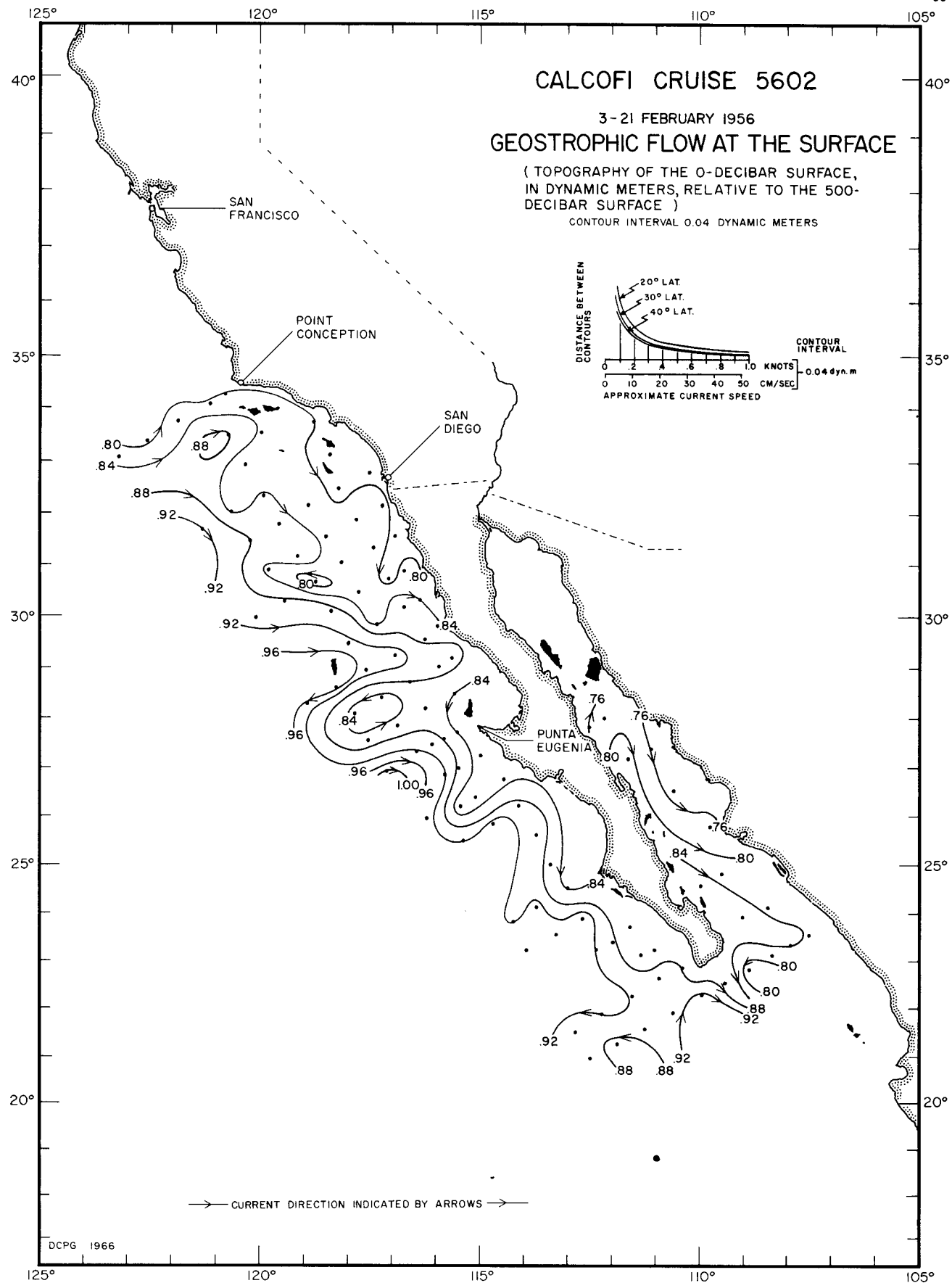


DCPG 1966

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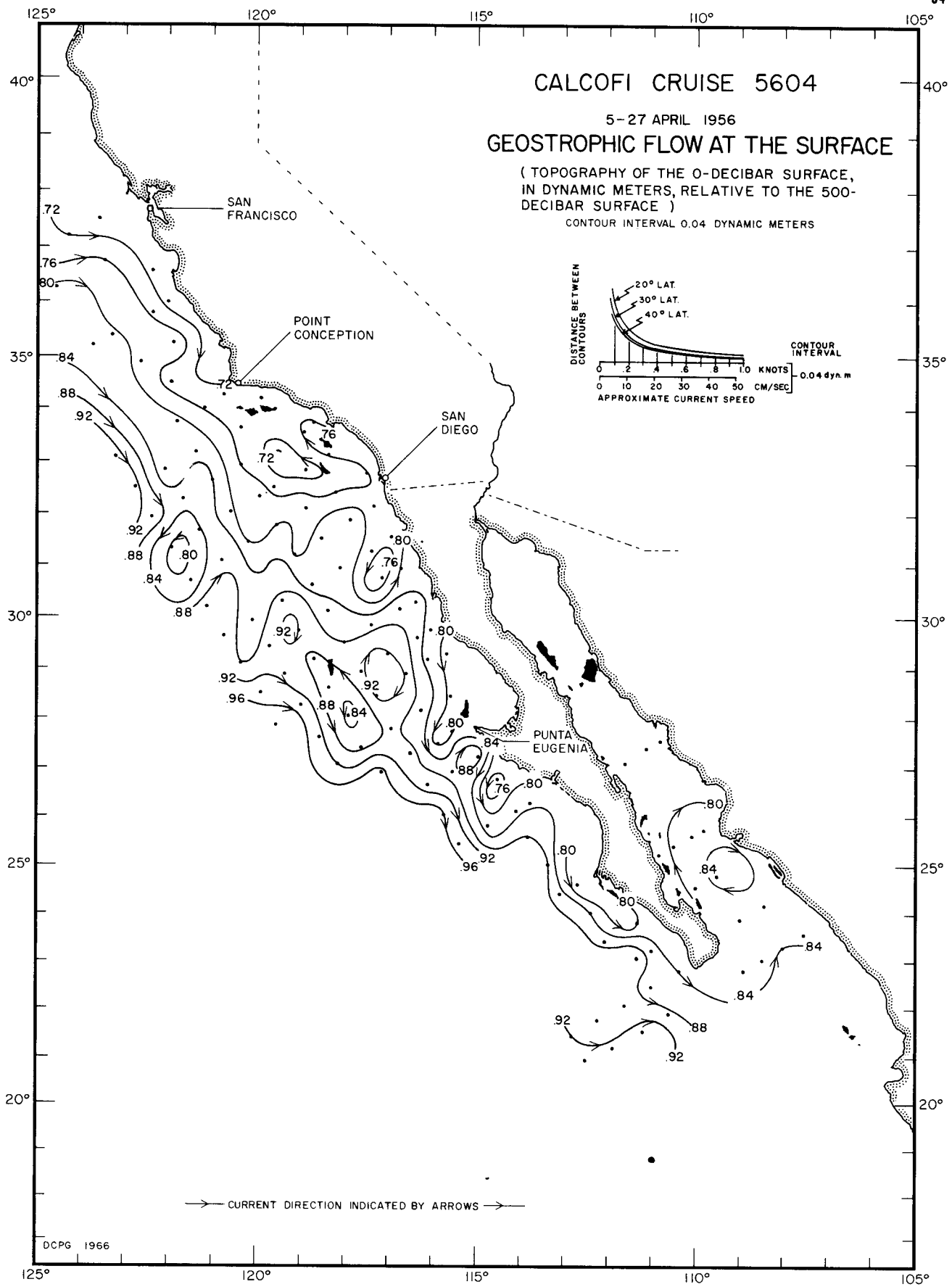






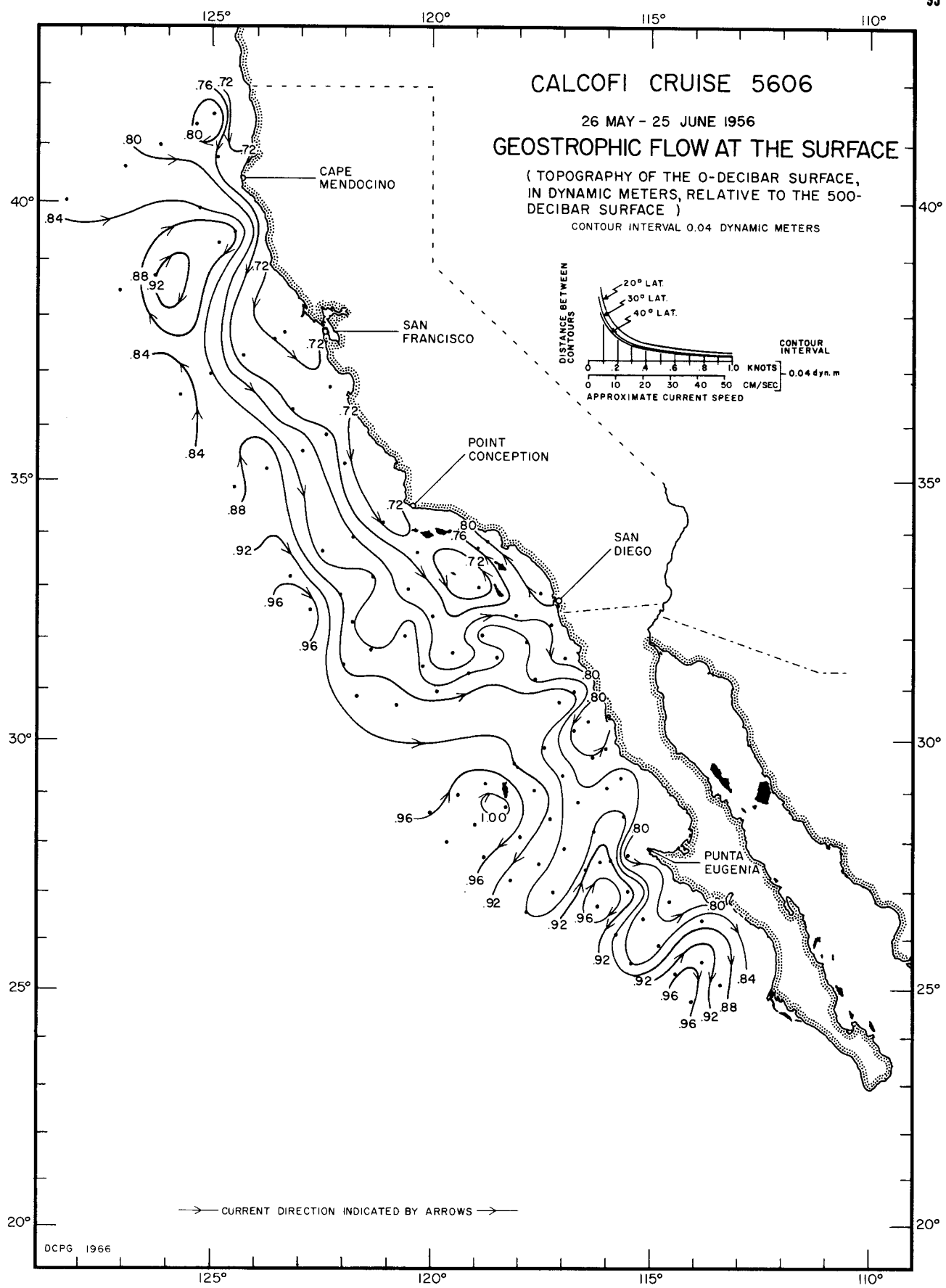
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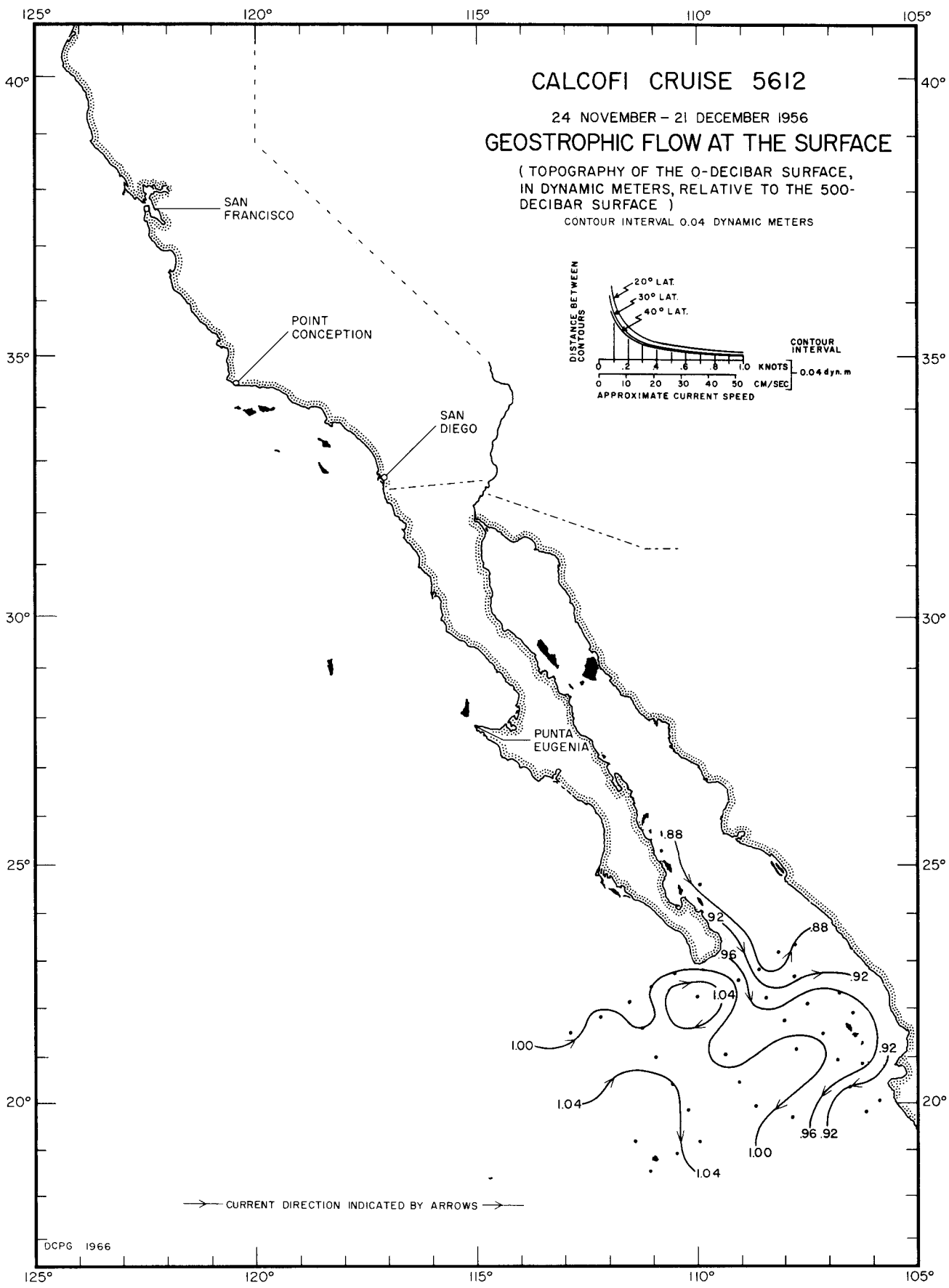


DCPG 1966

0/500 db  
5604

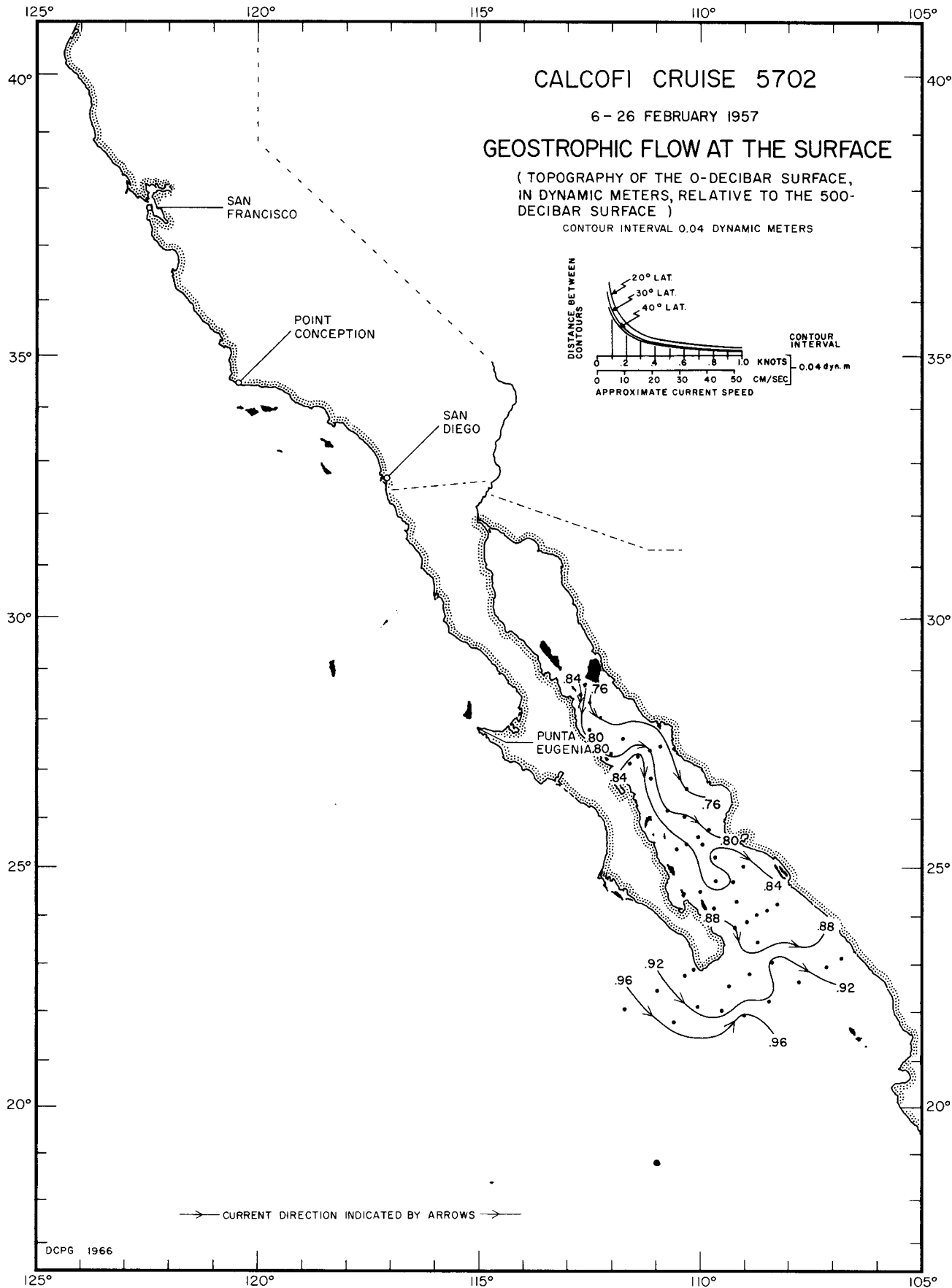


0/500 db  
 5606



DCPG 1966

O/500 db  
5612



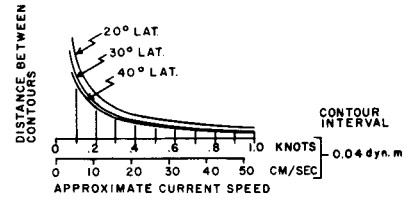
# CALCOFI CRUISE 5702

6 - 26 FEBRUARY 1957

## GEOSTROPHIC FLOW AT THE SURFACE

( TOPOGRAPHY OF THE 0-DECIBAR SURFACE, IN DYNAMIC METERS, RELATIVE TO THE 500-DECIBAR SURFACE )

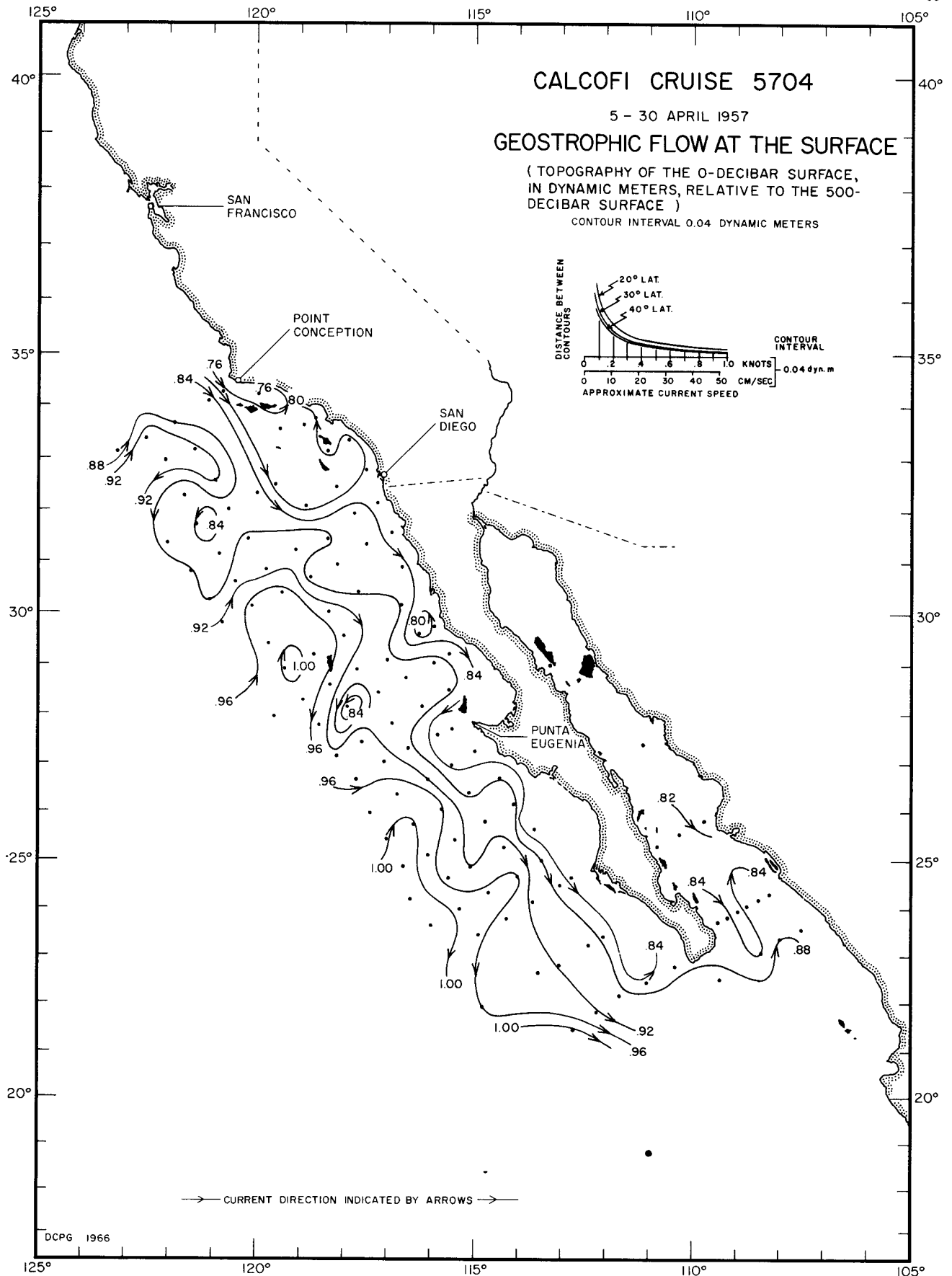
CONTOUR INTERVAL 0.04 DYNAMIC METERS



→ CURRENT DIRECTION INDICATED BY ARROWS →

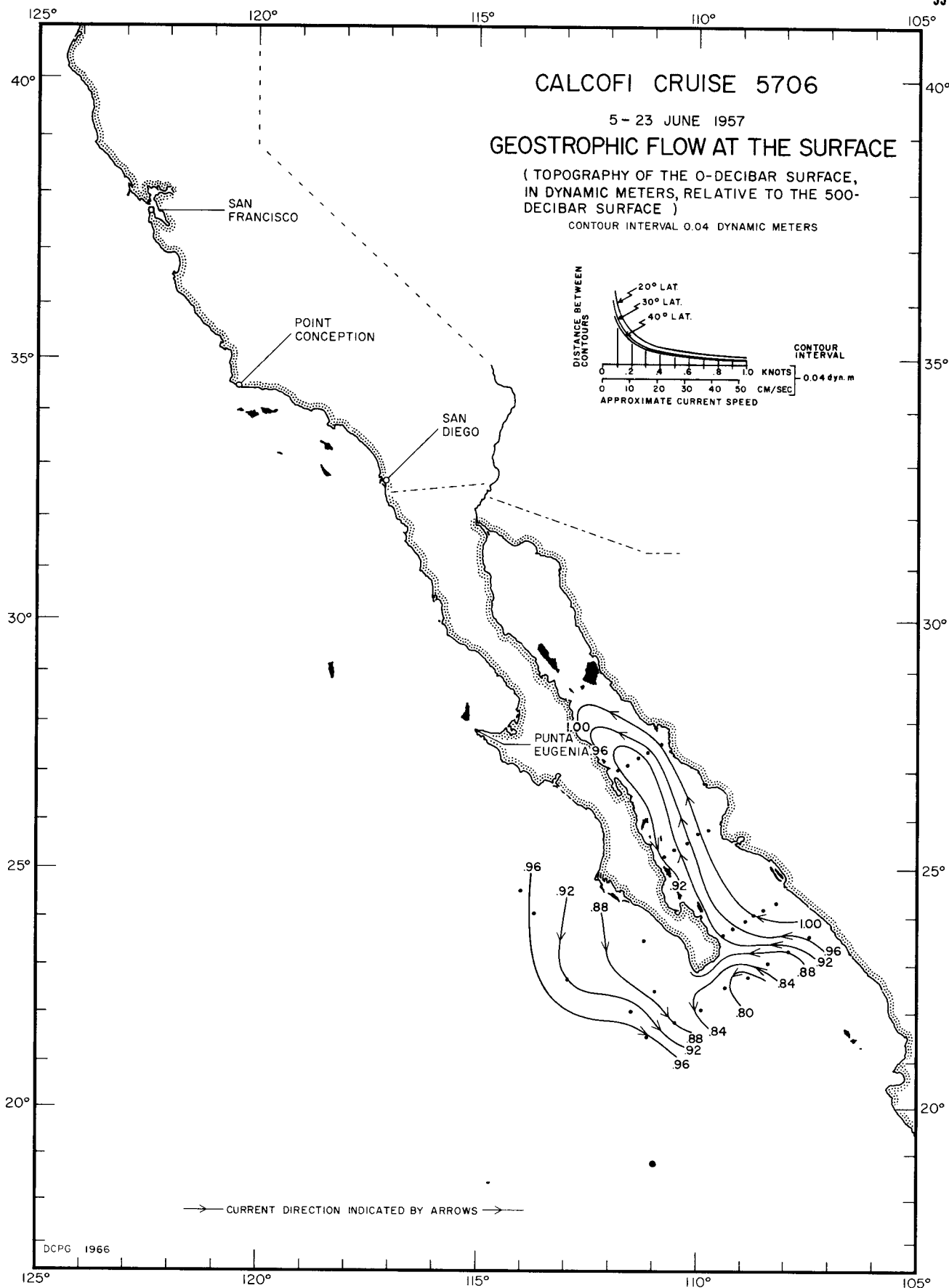
DCPG 1966

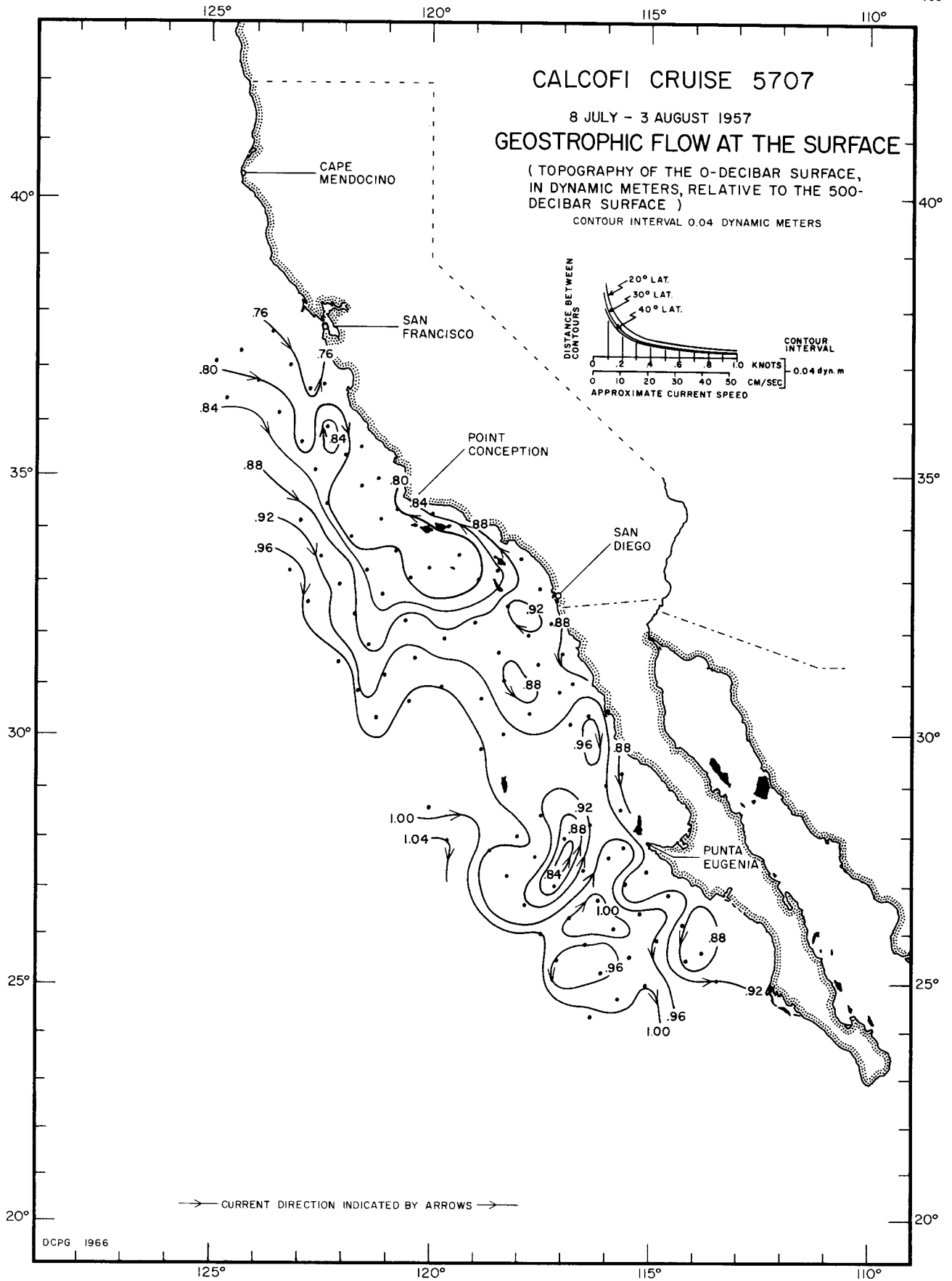
O/500 db  
5702



DCPG 1966

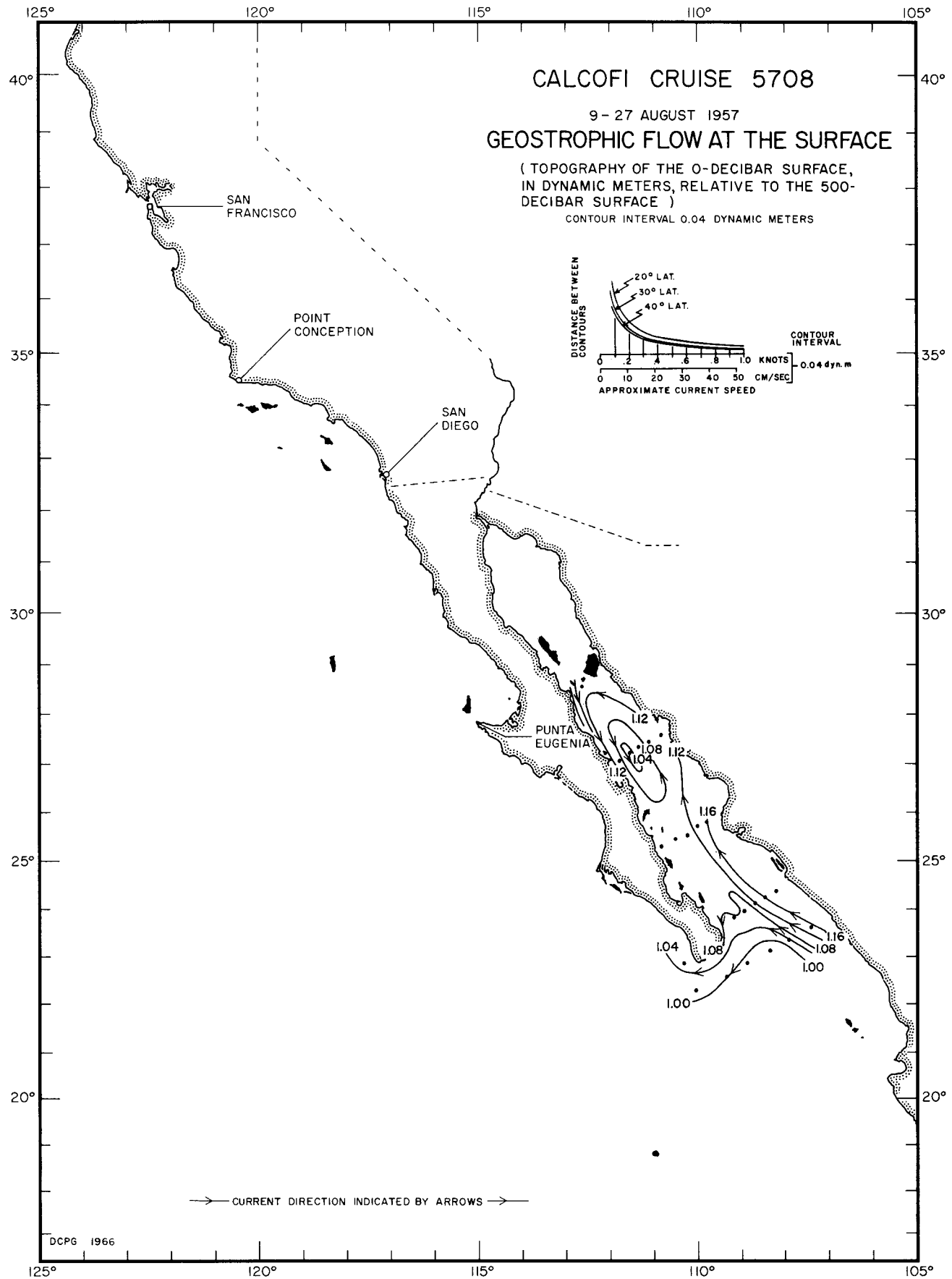
O/500 db  
5704





DCPG 1966

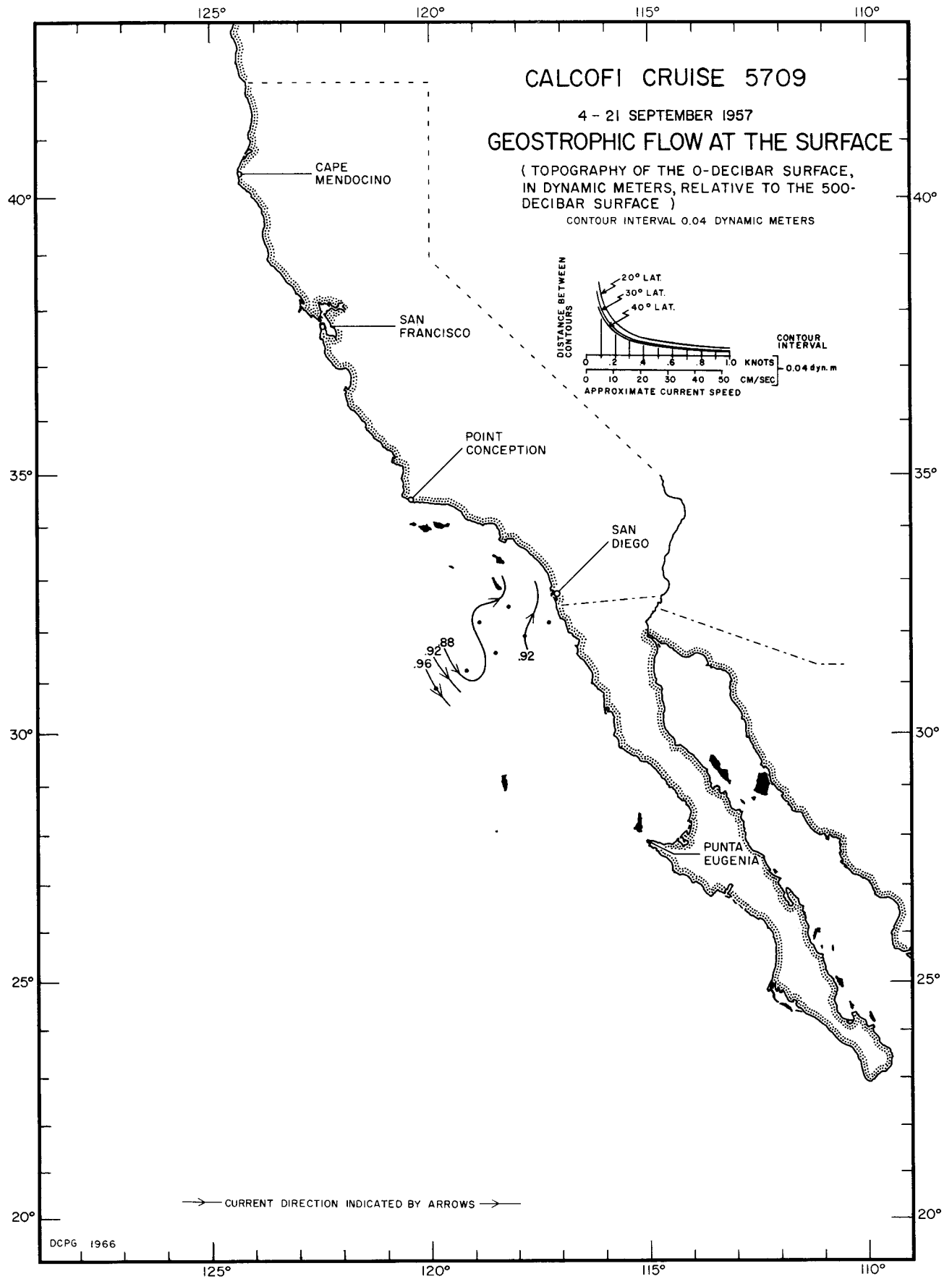
O/500 db  
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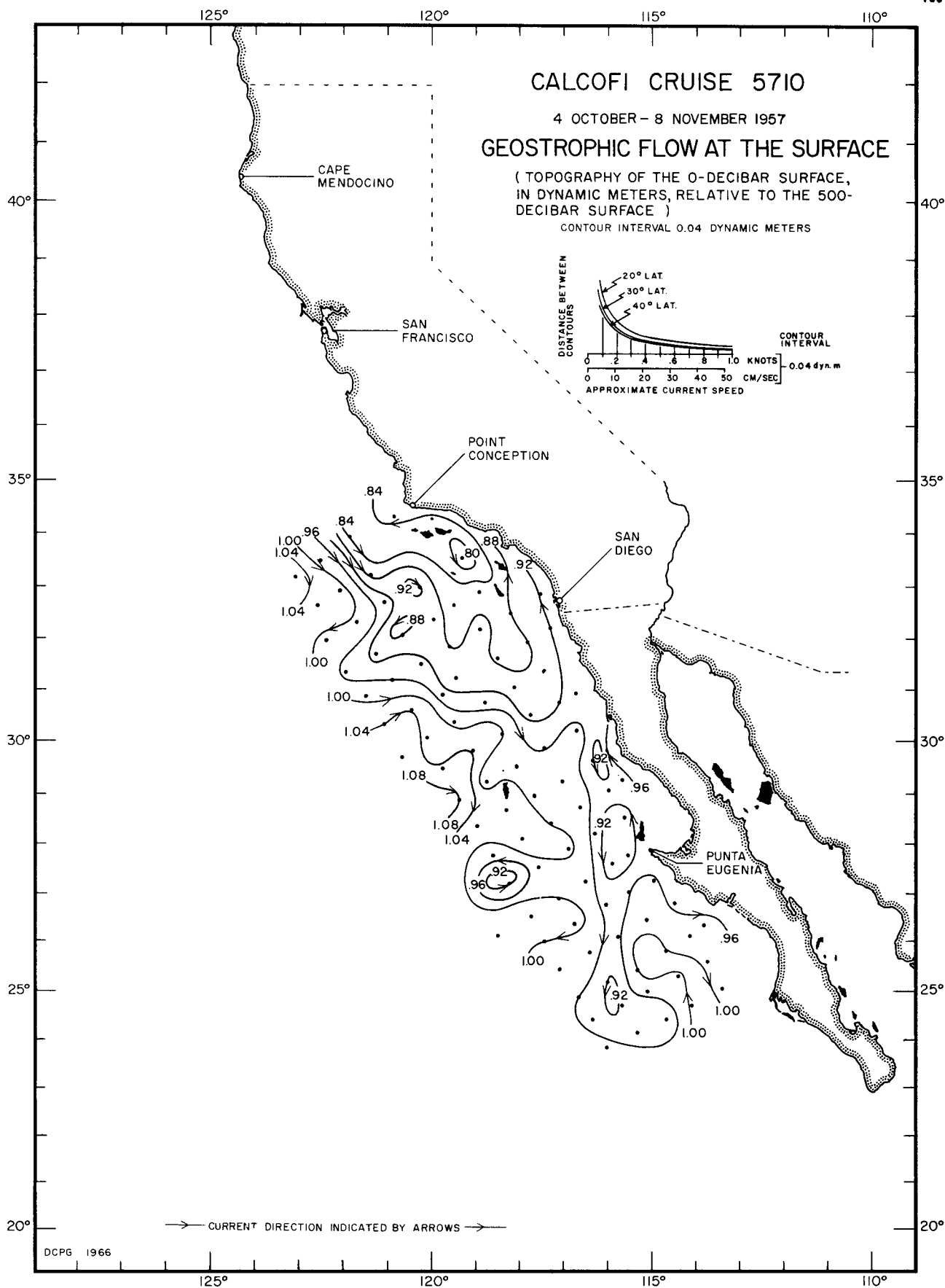
DCPG 1966

0/500 db  
5708



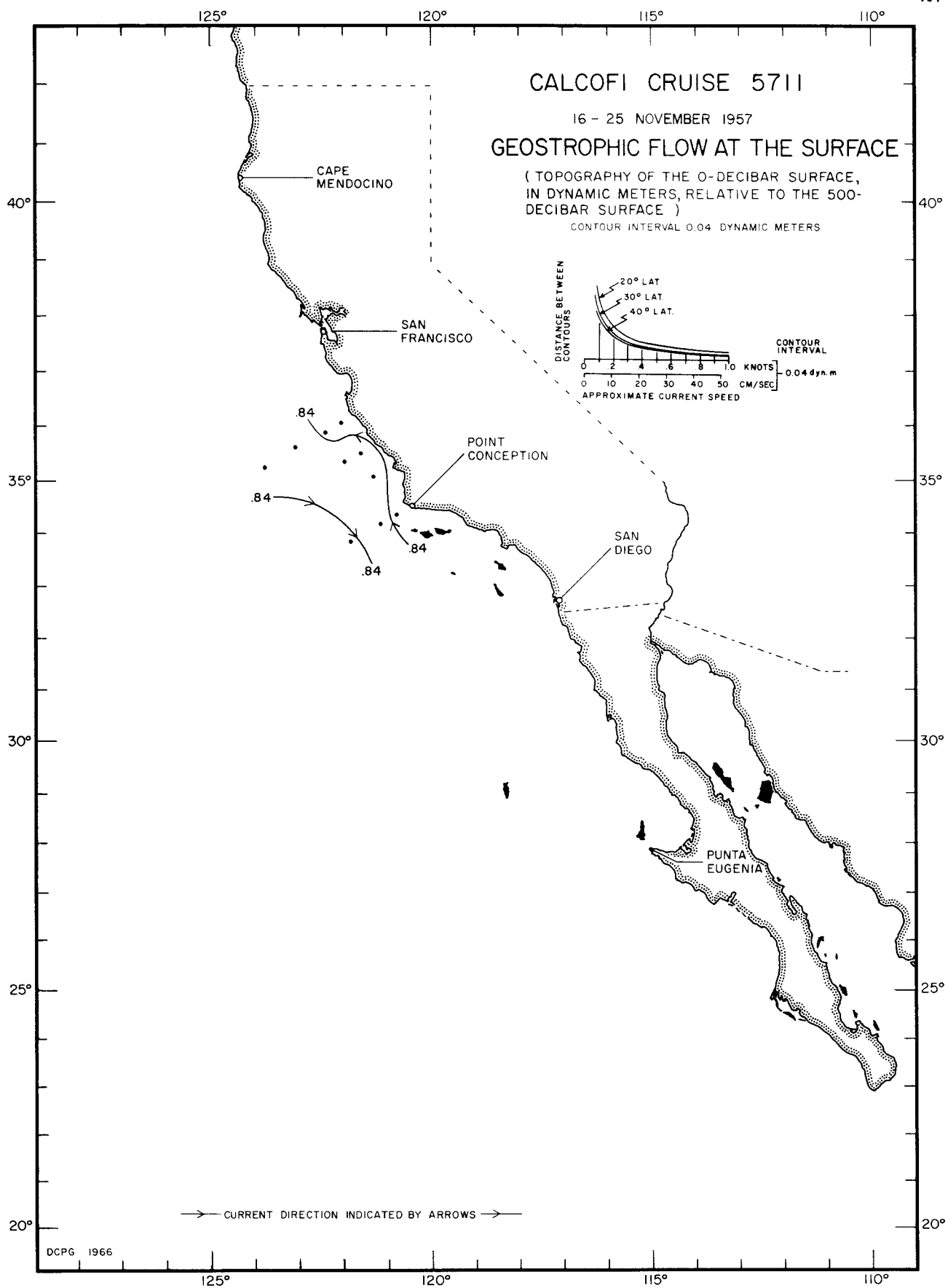


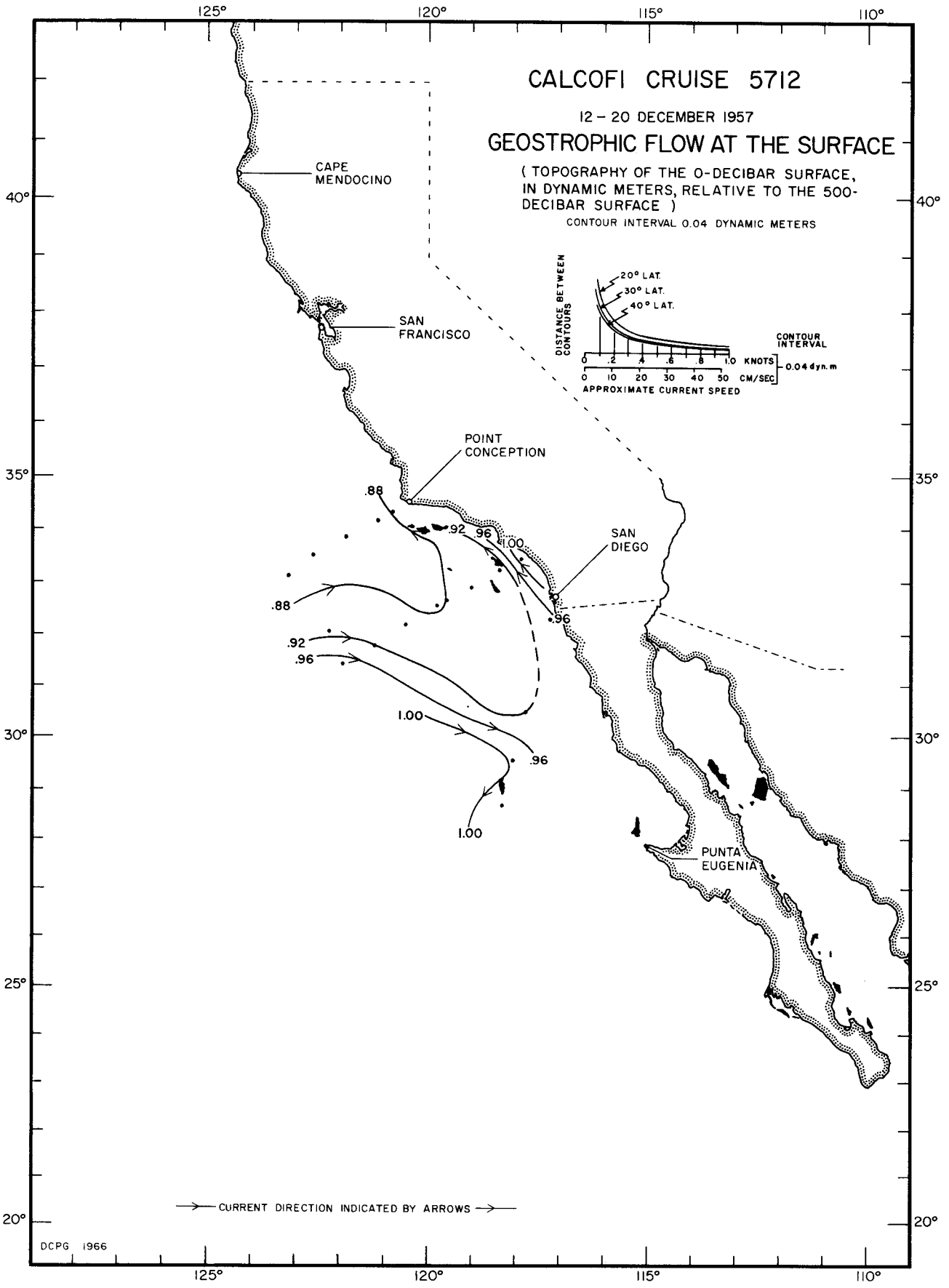
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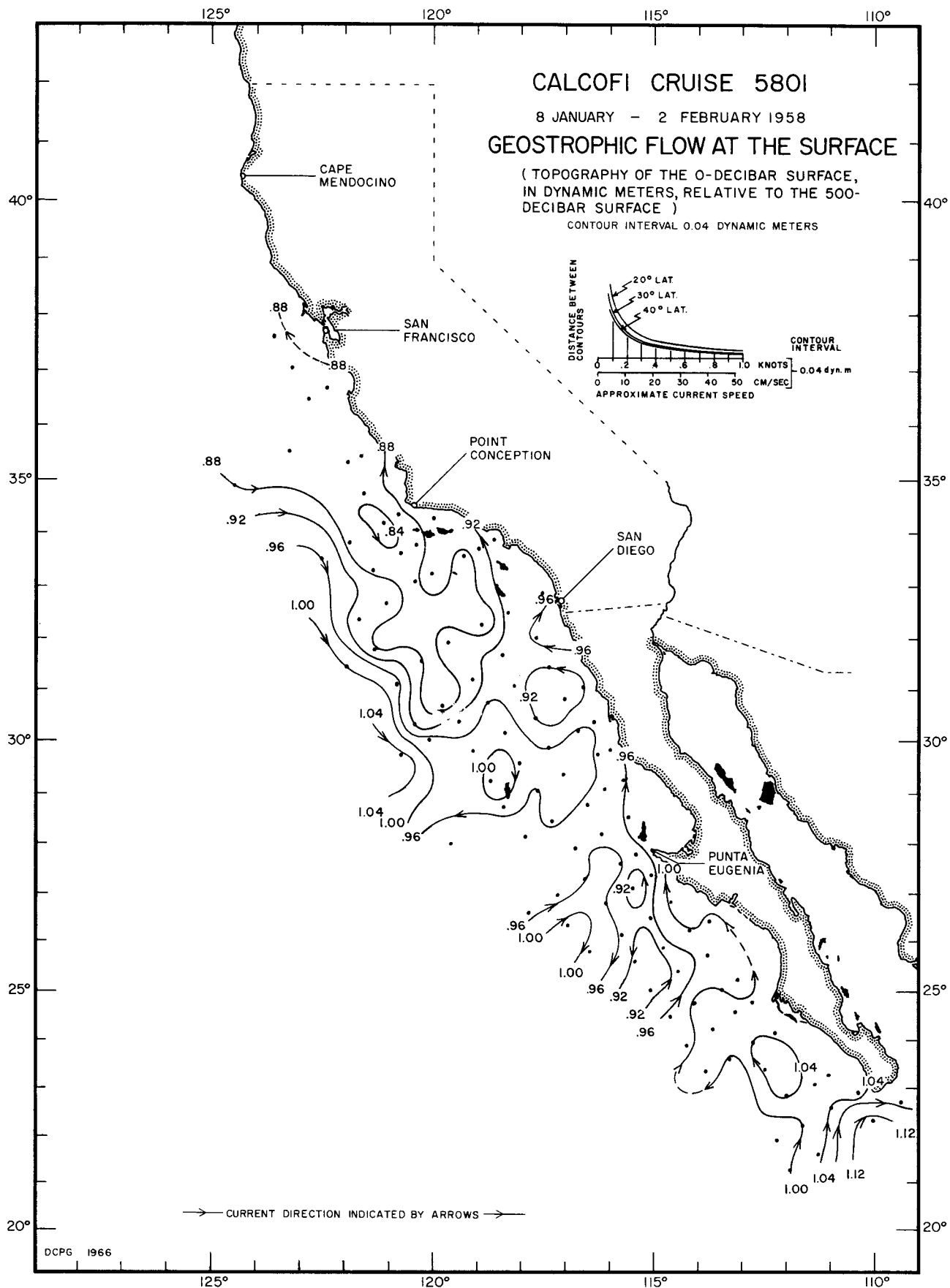
DCPG 1966

0/500 db  
 5710



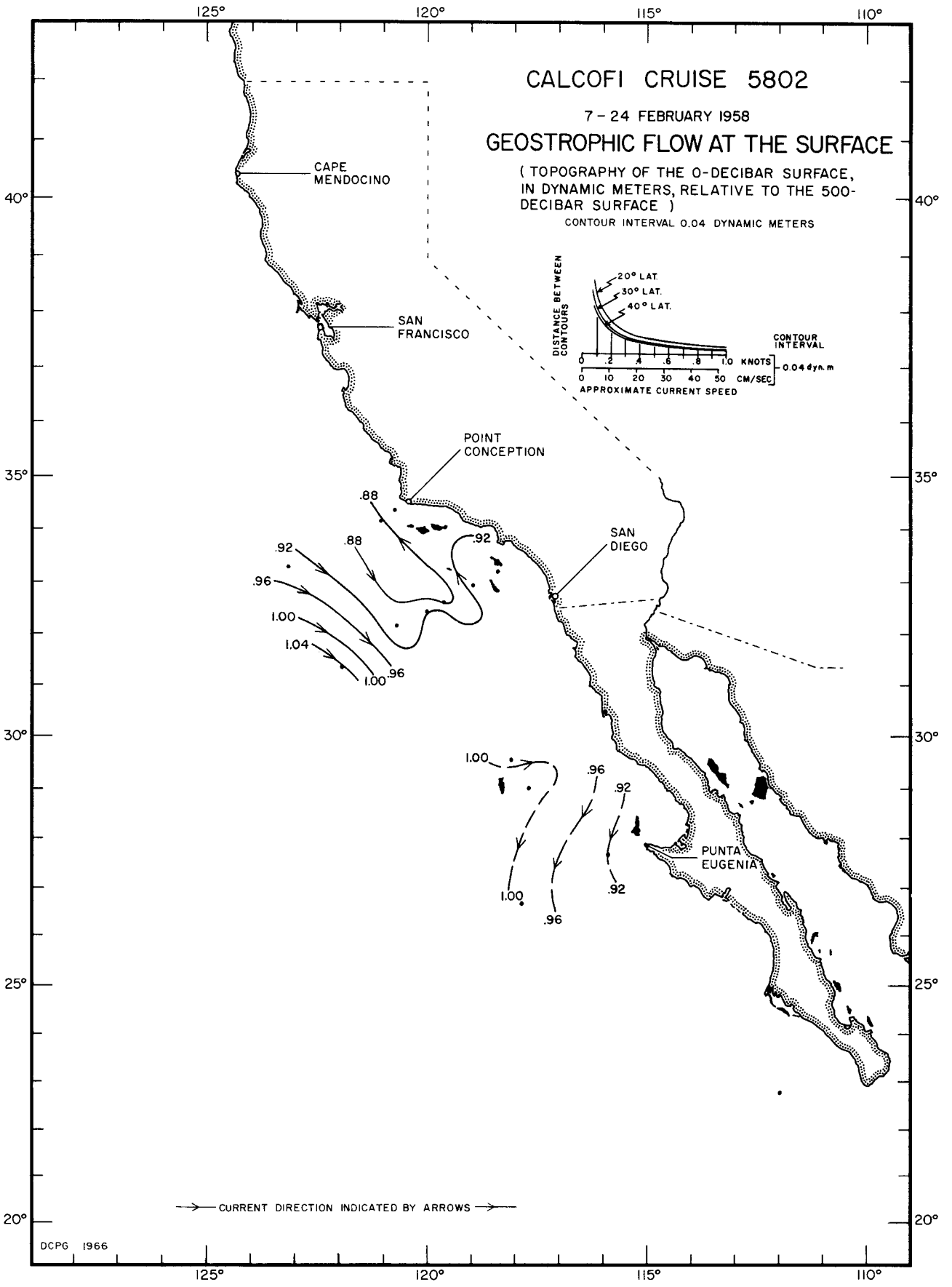


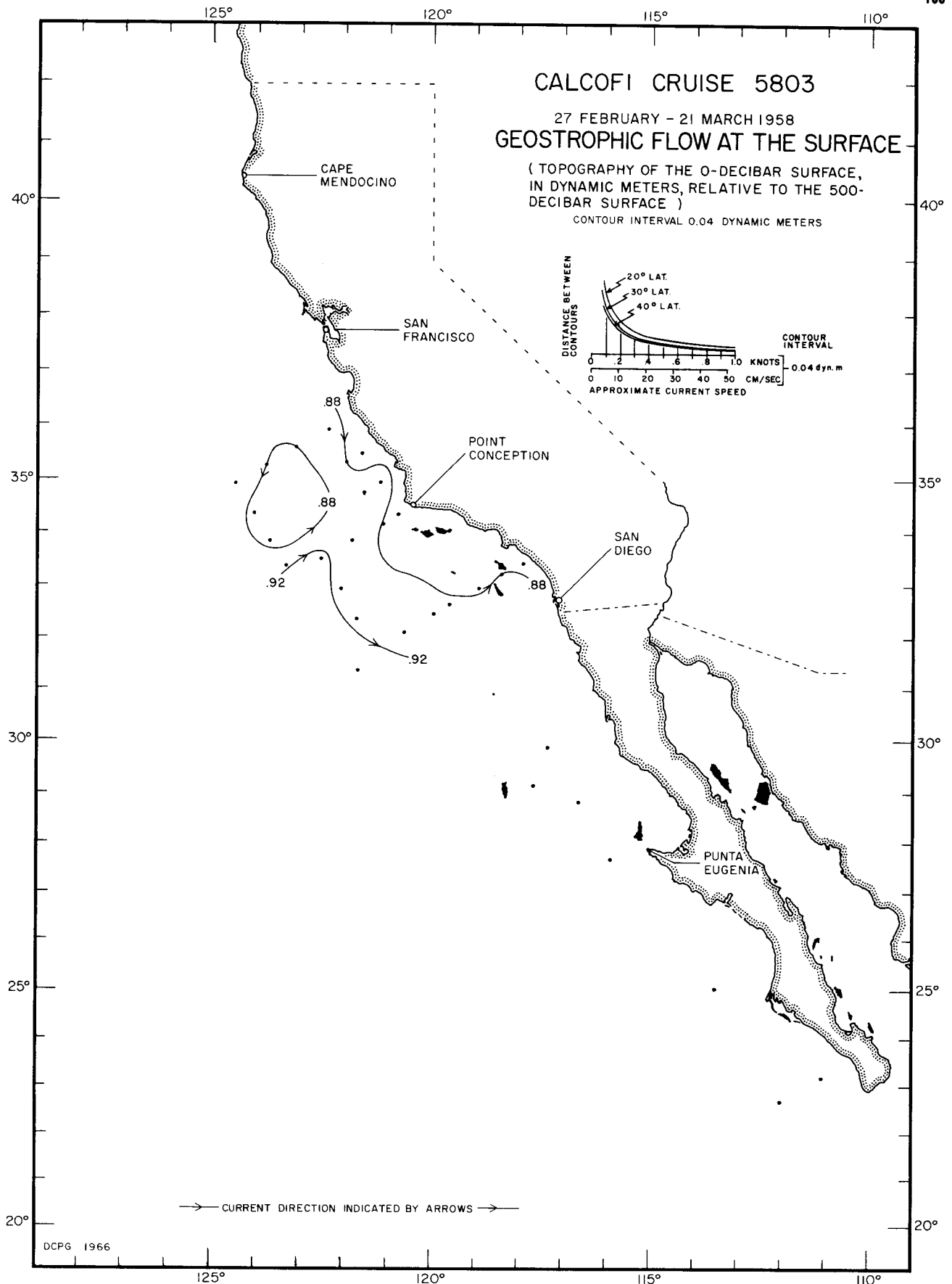
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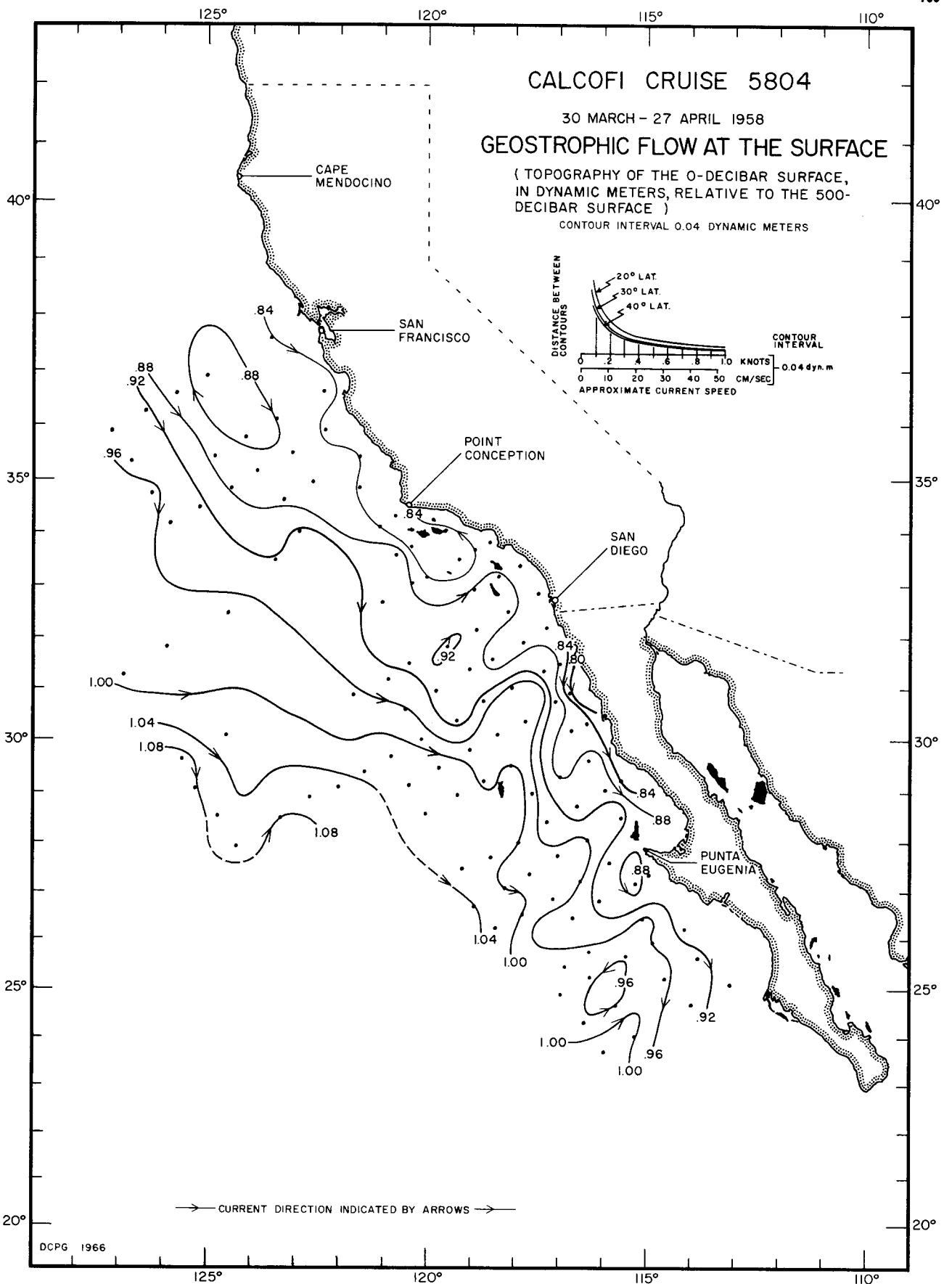
DCPG 1966

O/500 db  
 5801



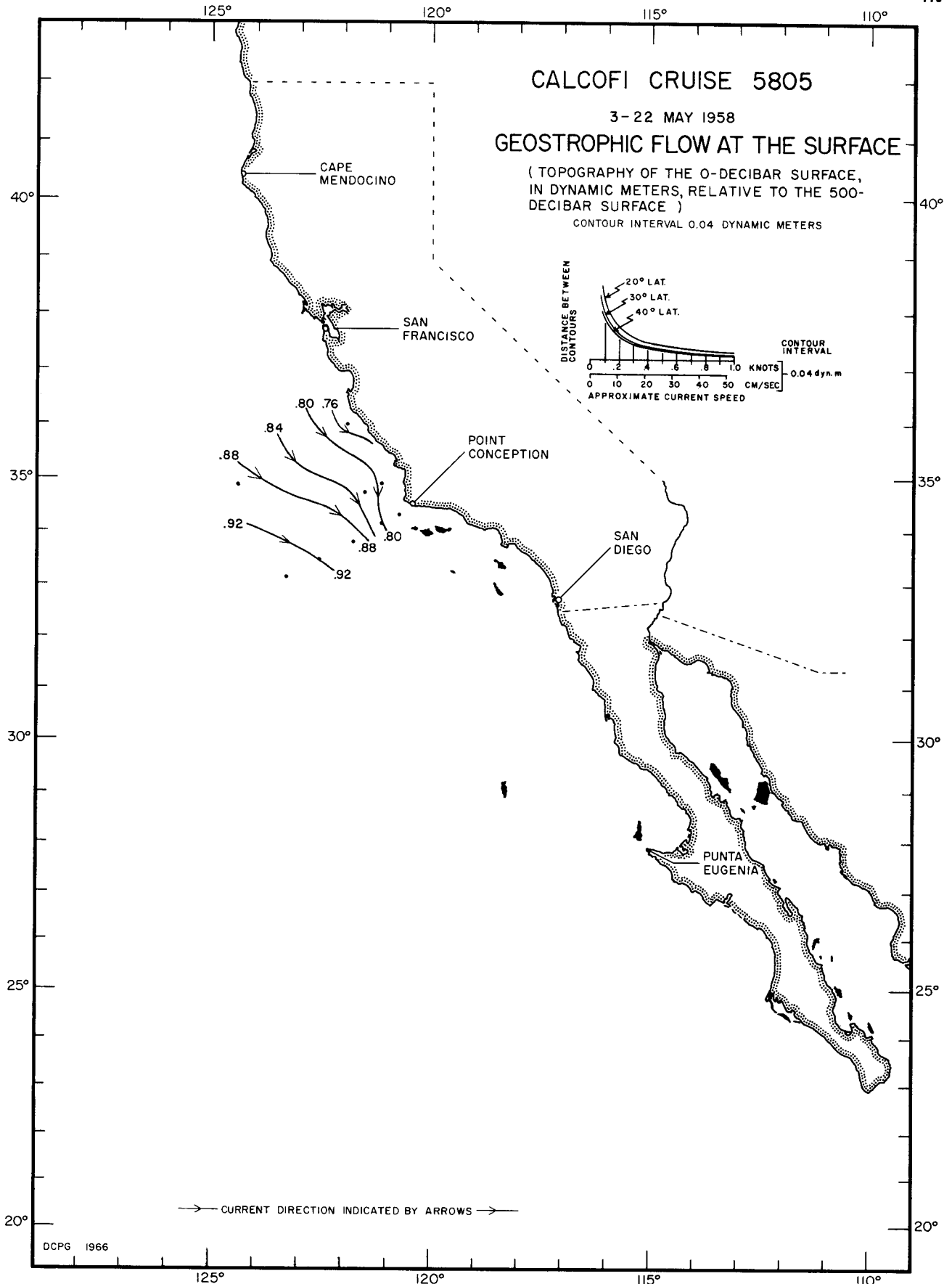


O/500 db  
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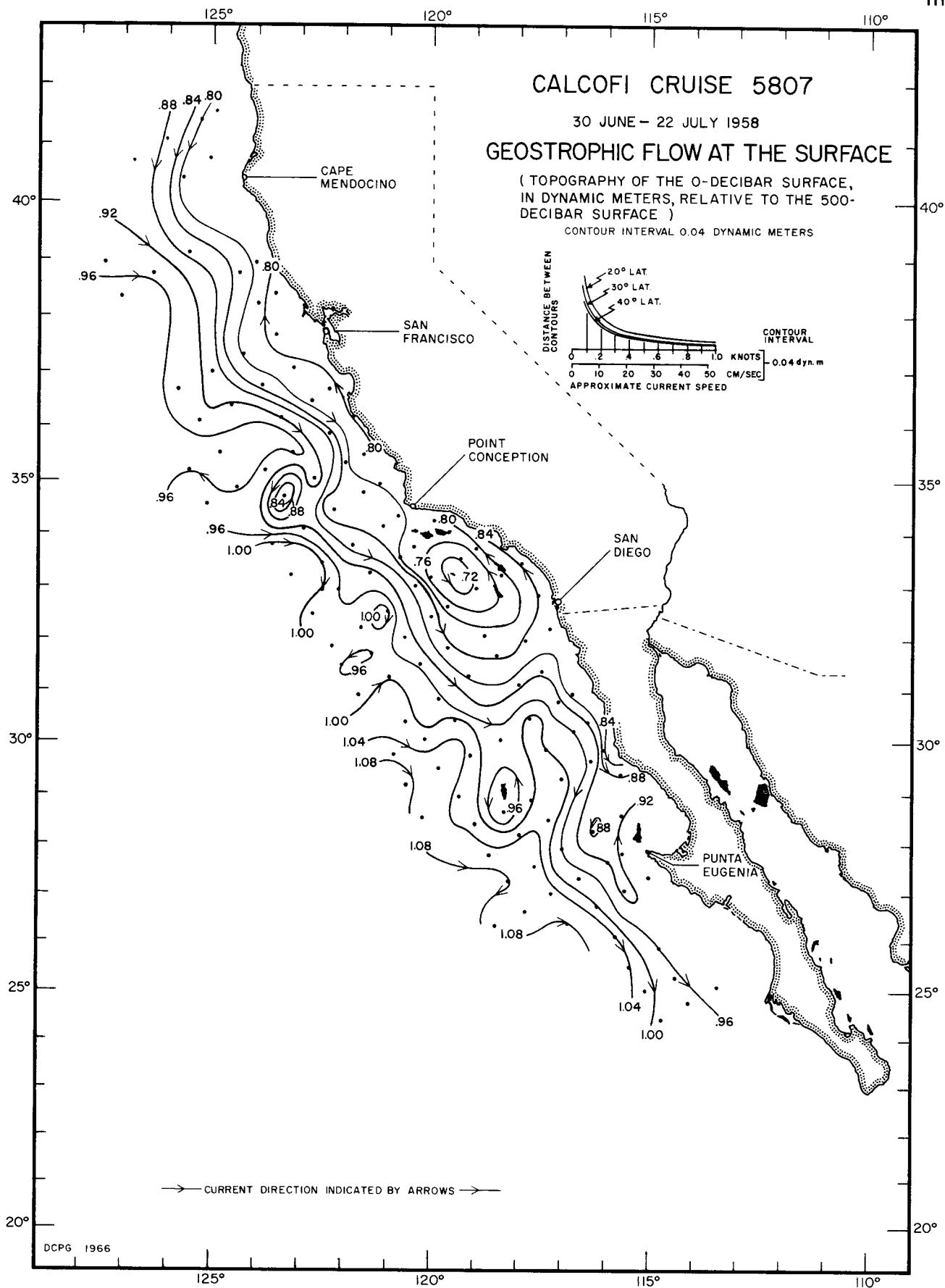


0/500 db  
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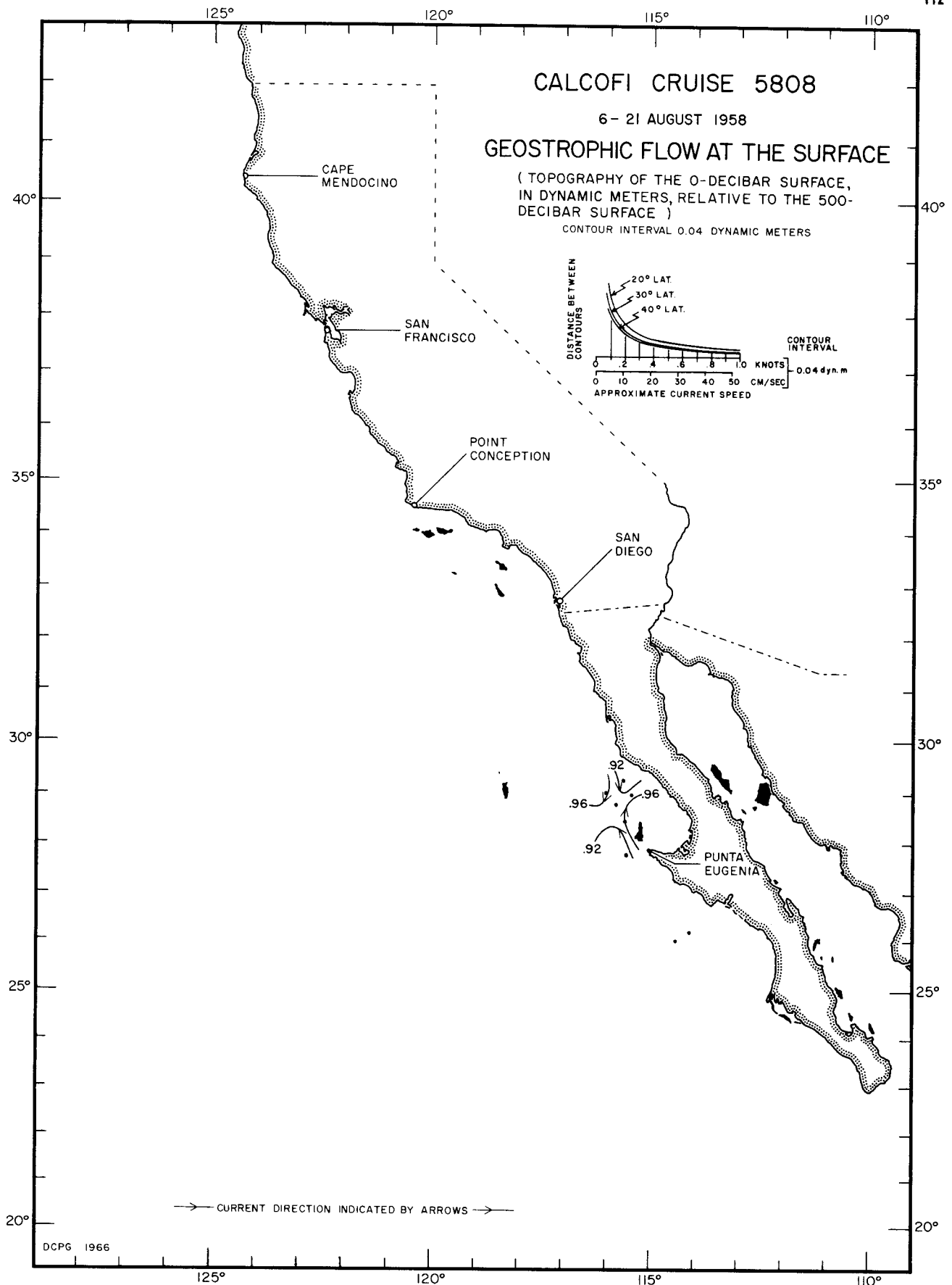


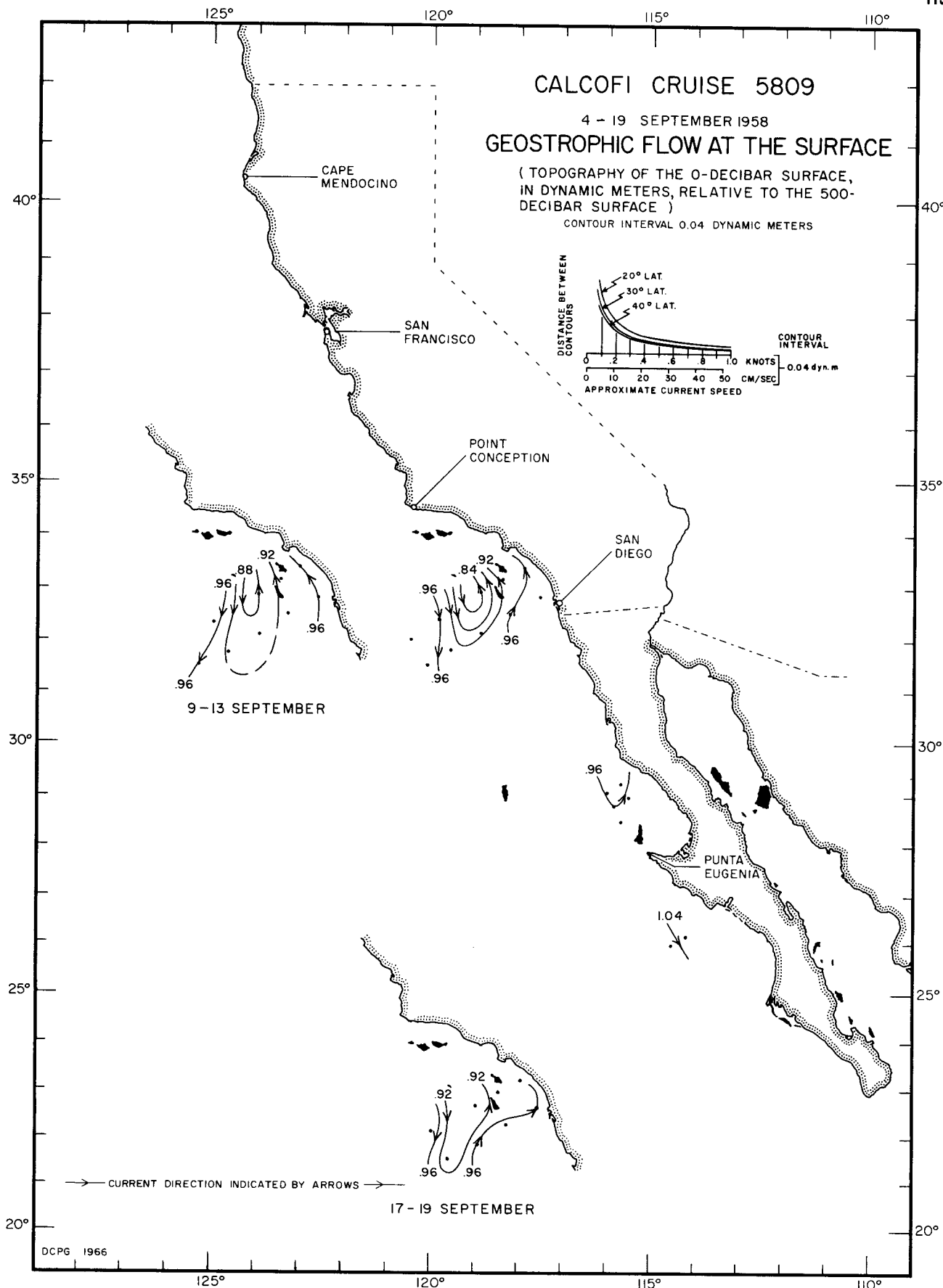


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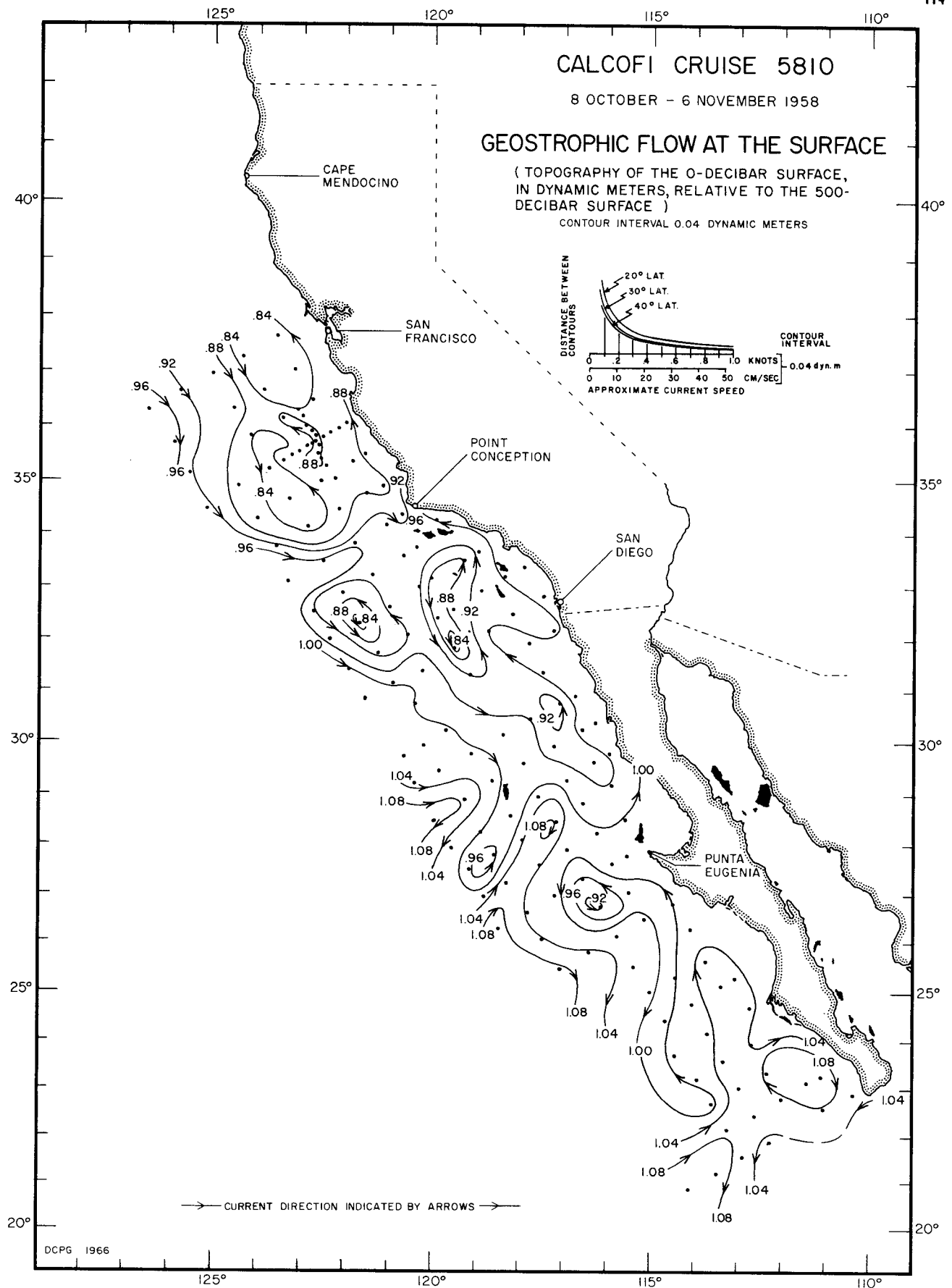
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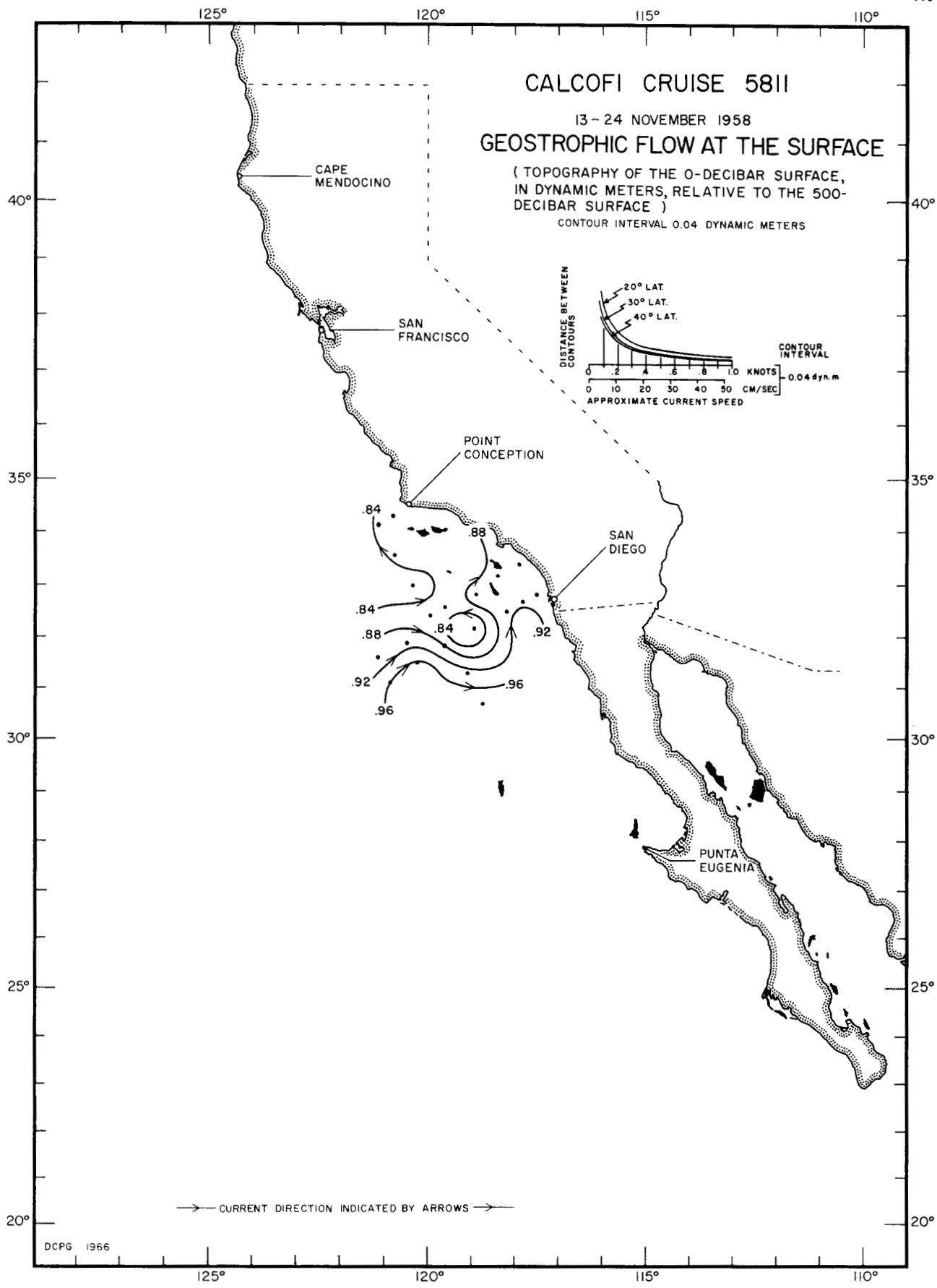


DCPG 1966

0/500 db  
5809



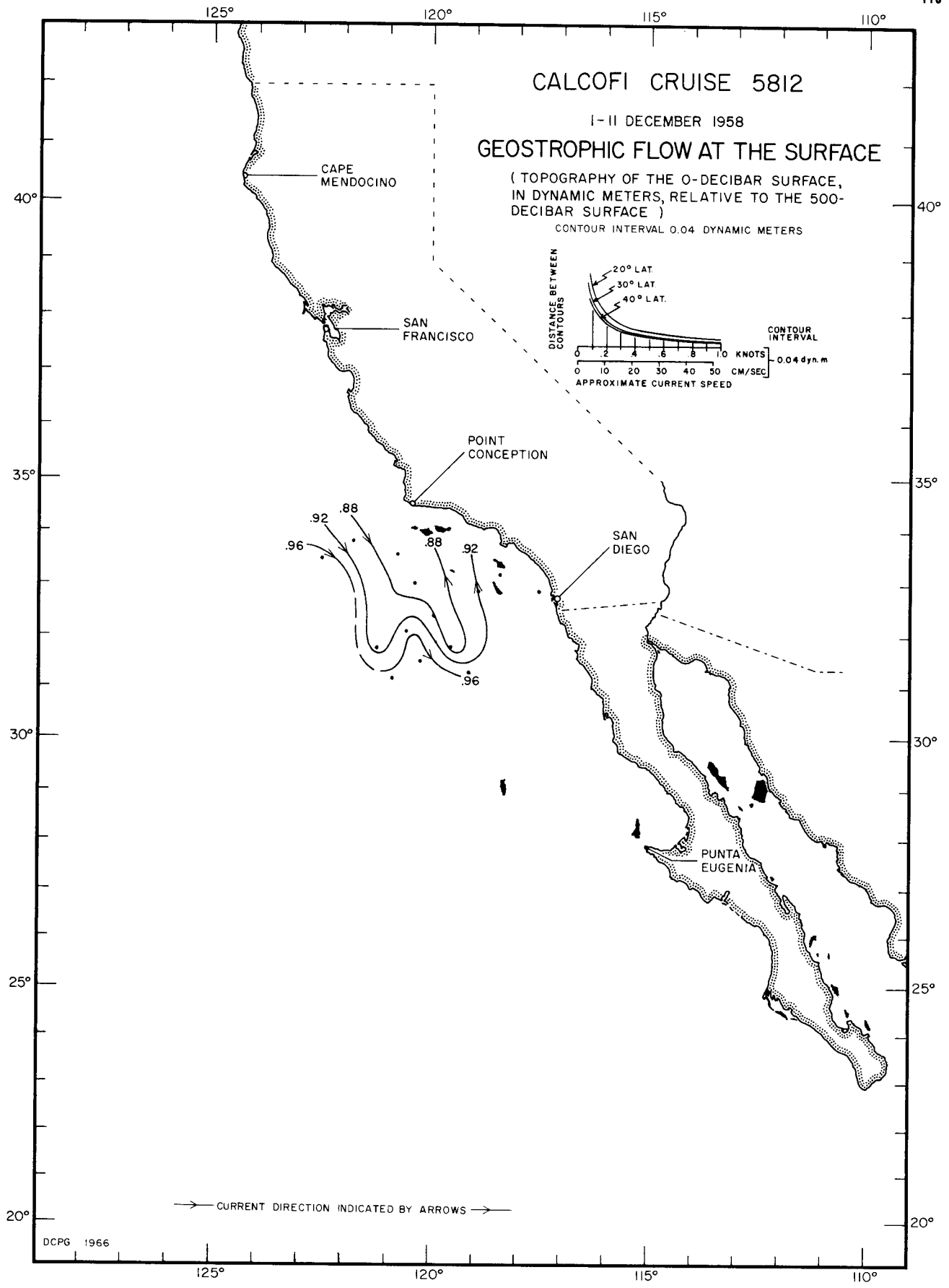
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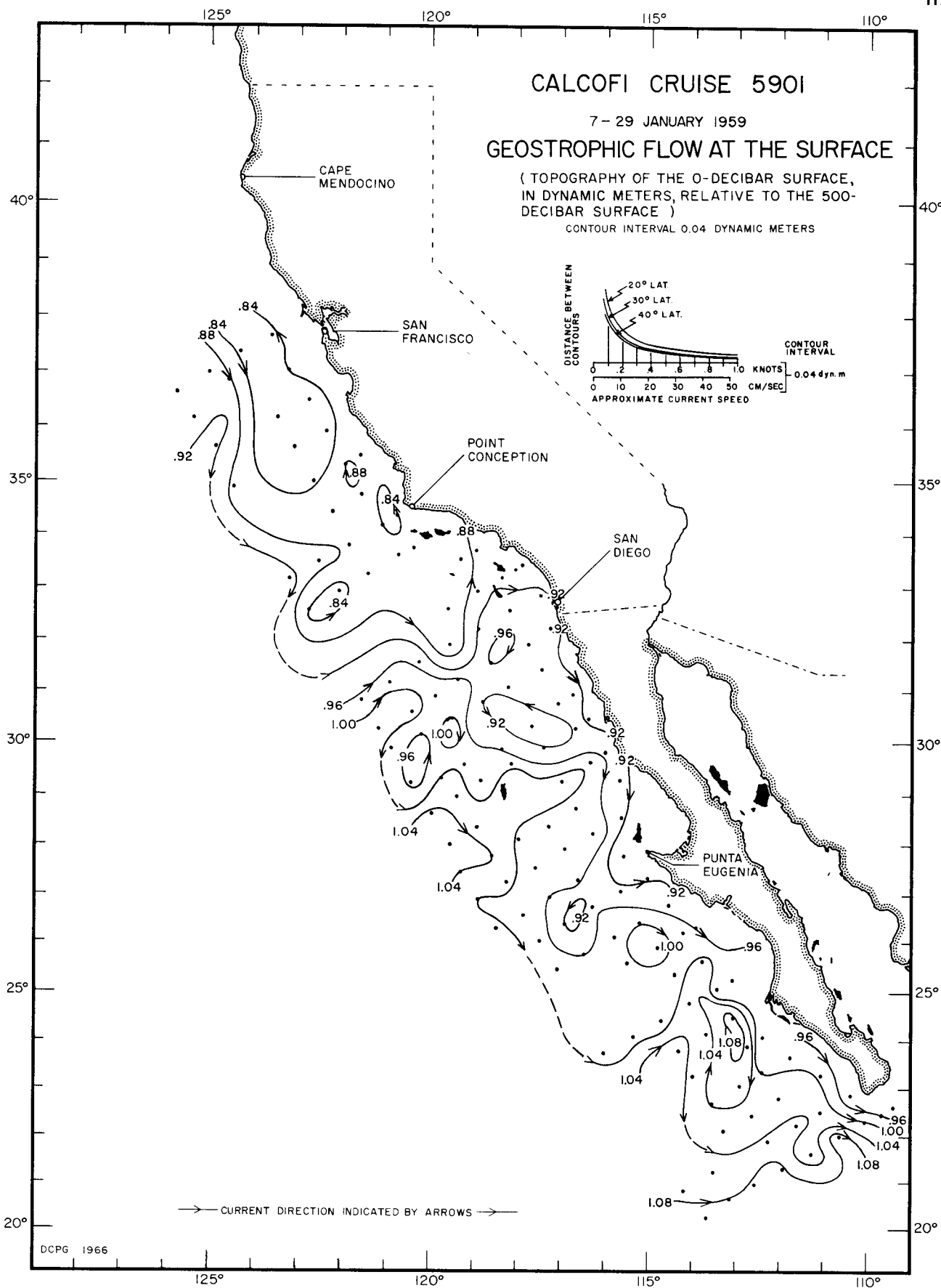


DCPG 1966

0/500 db

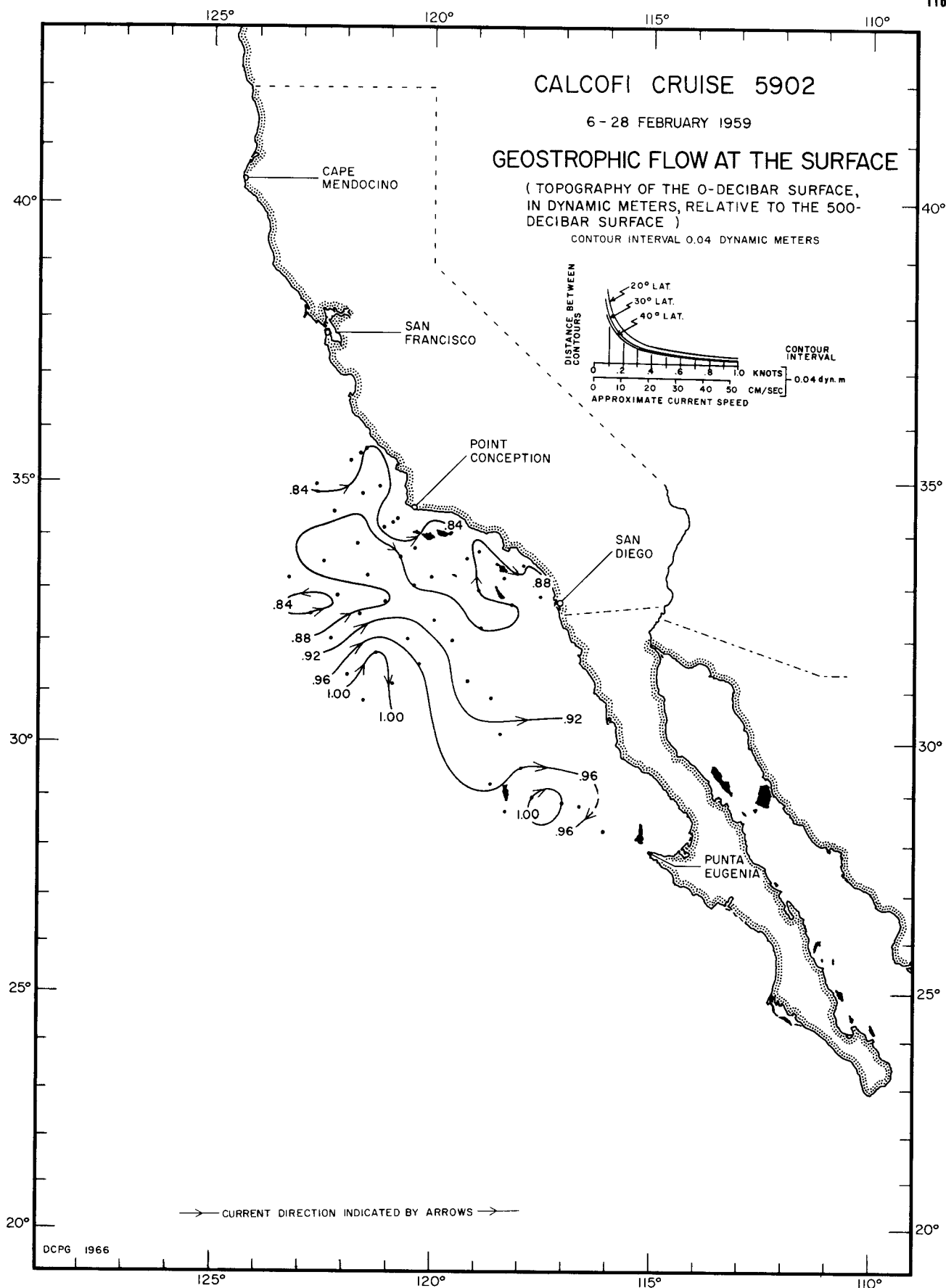
5811



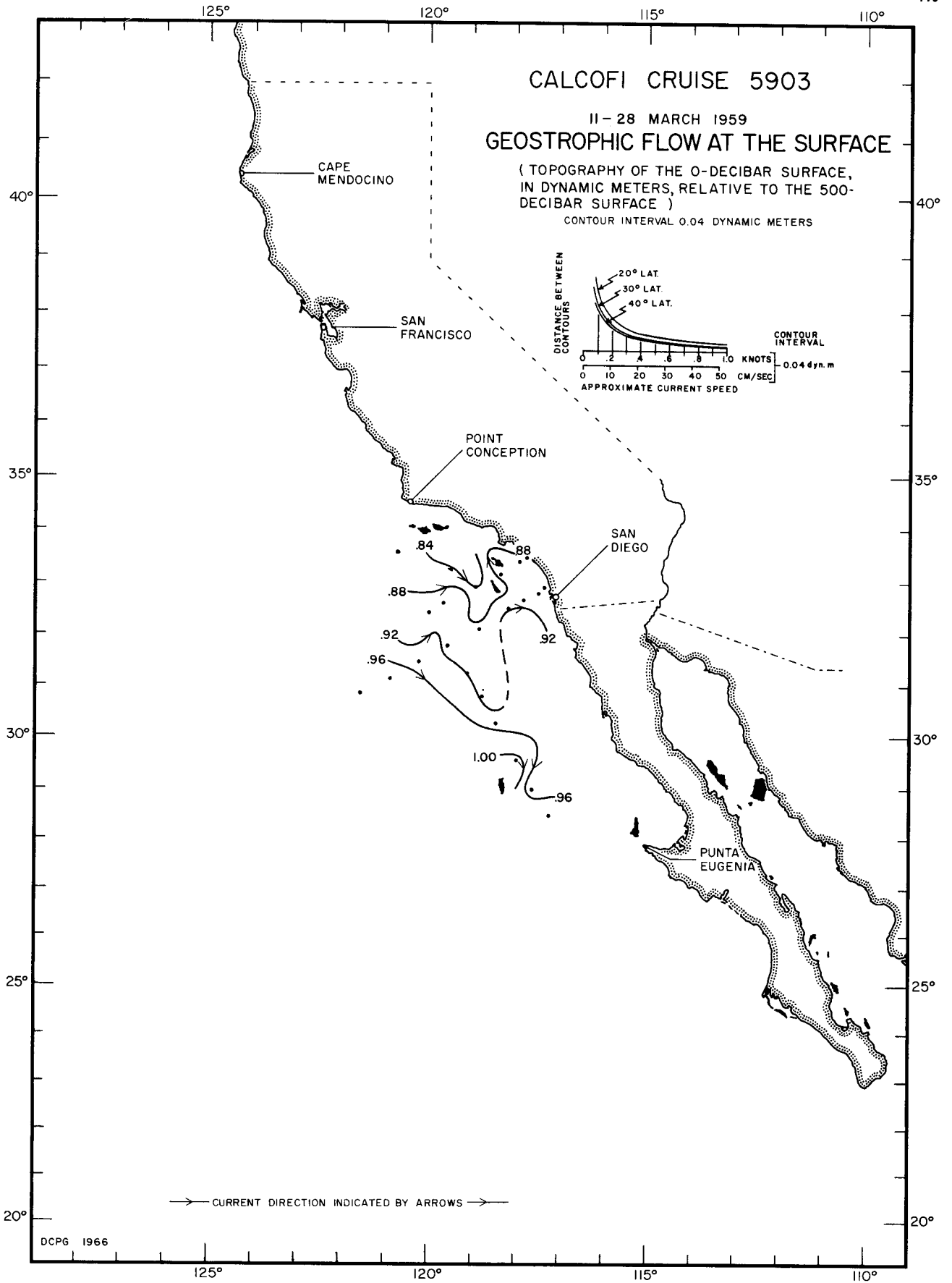


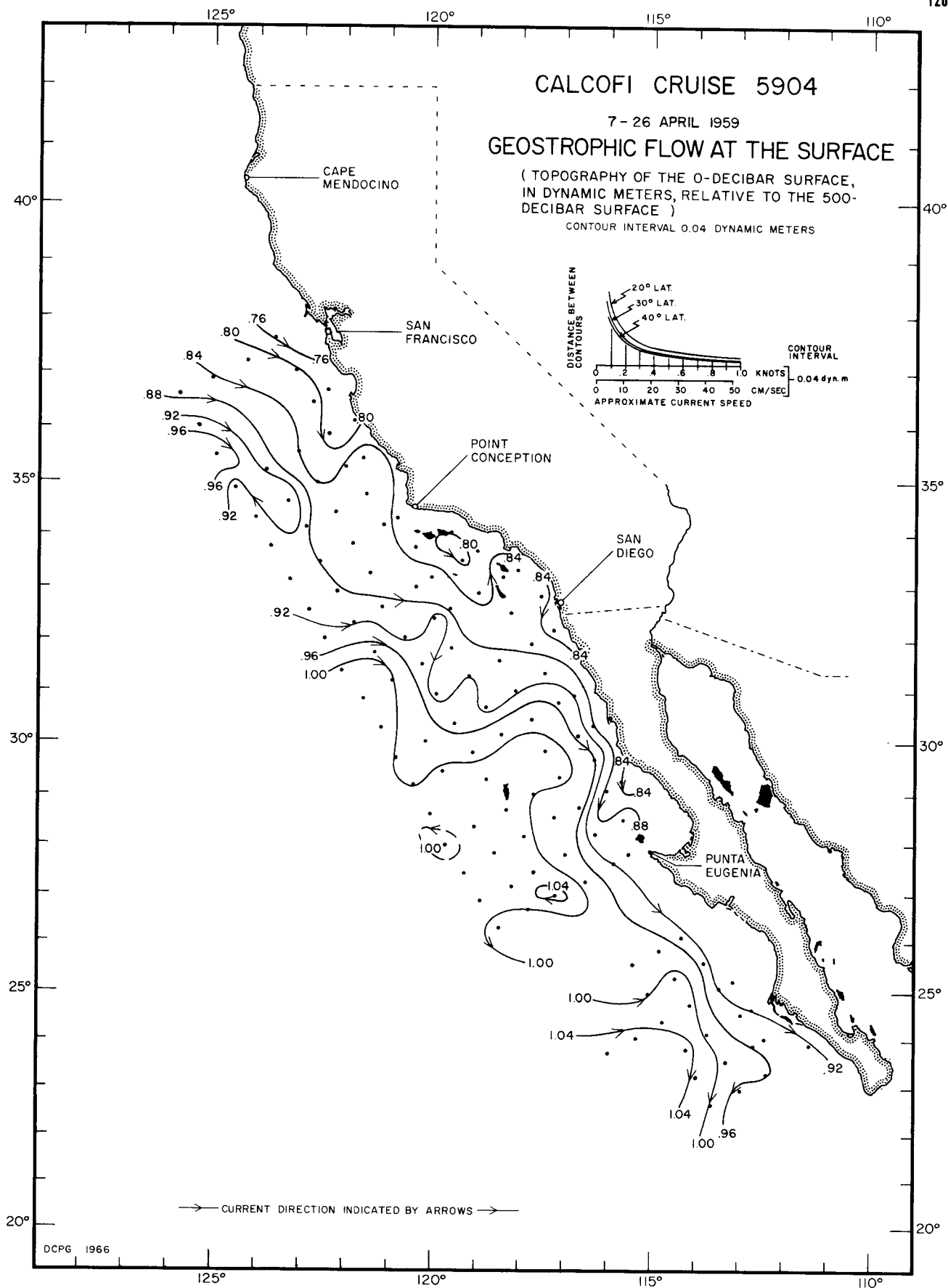
0/500 db  
5901



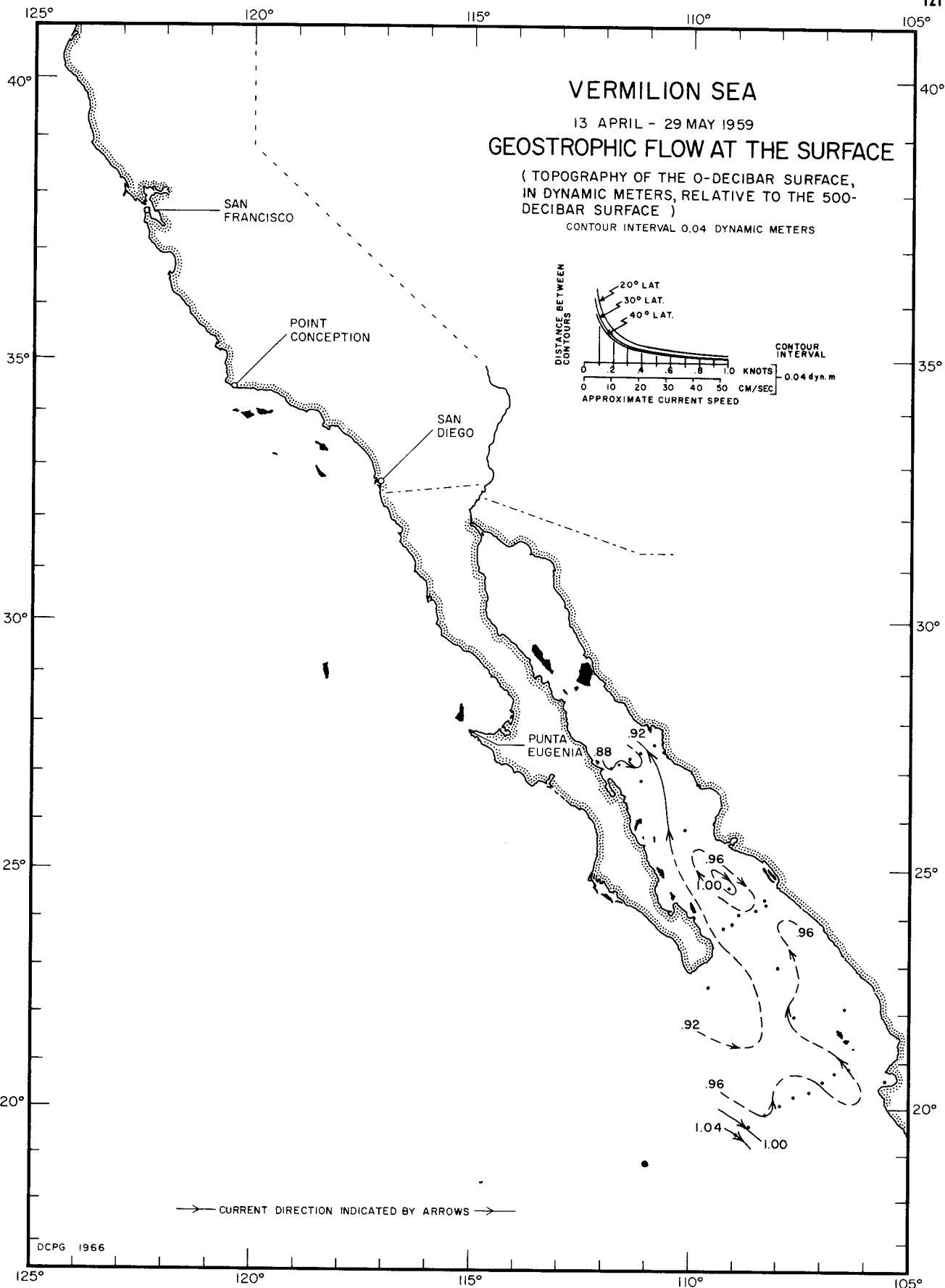


O/500 db  
5902

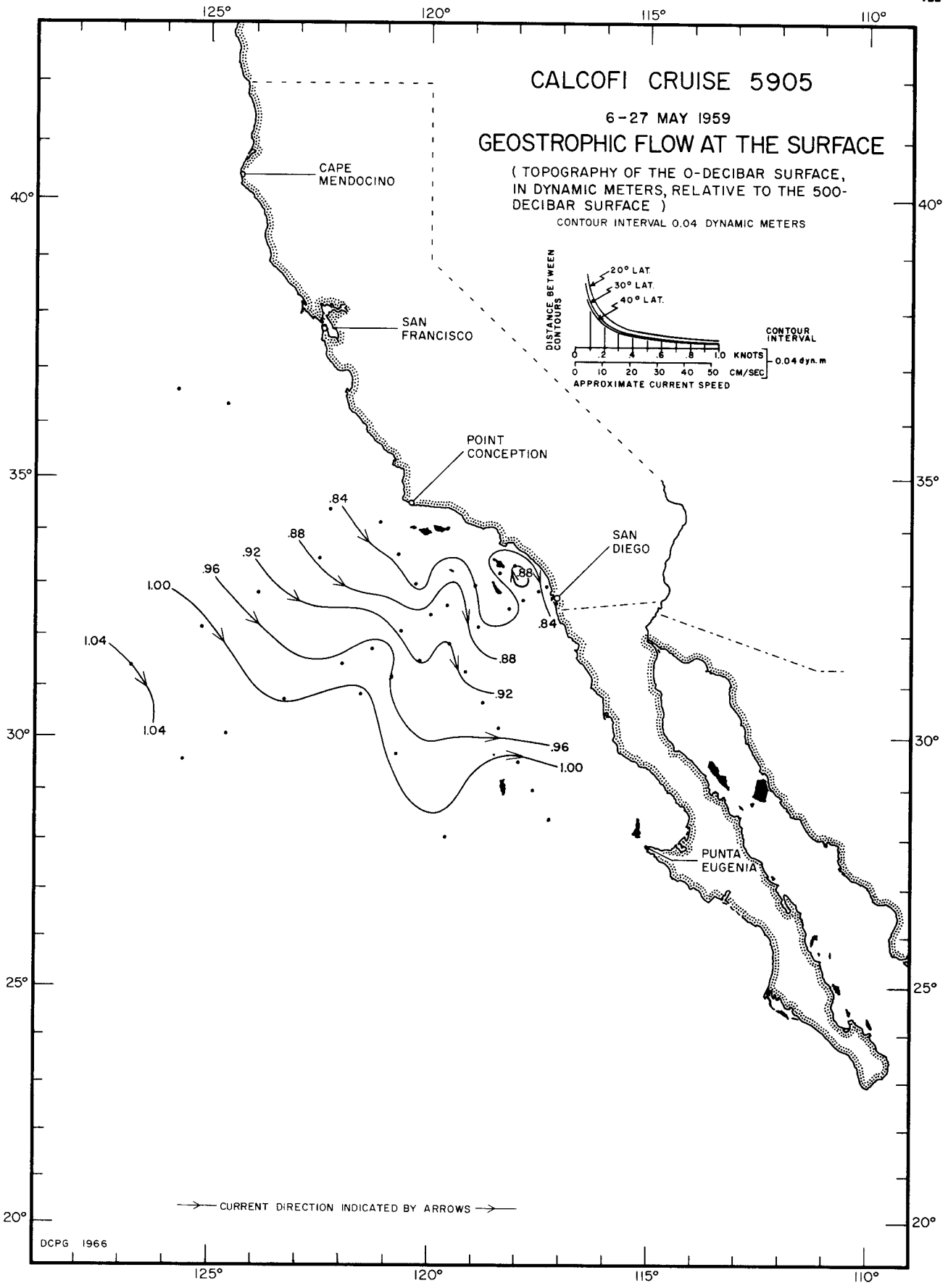




0/500 db  
5904

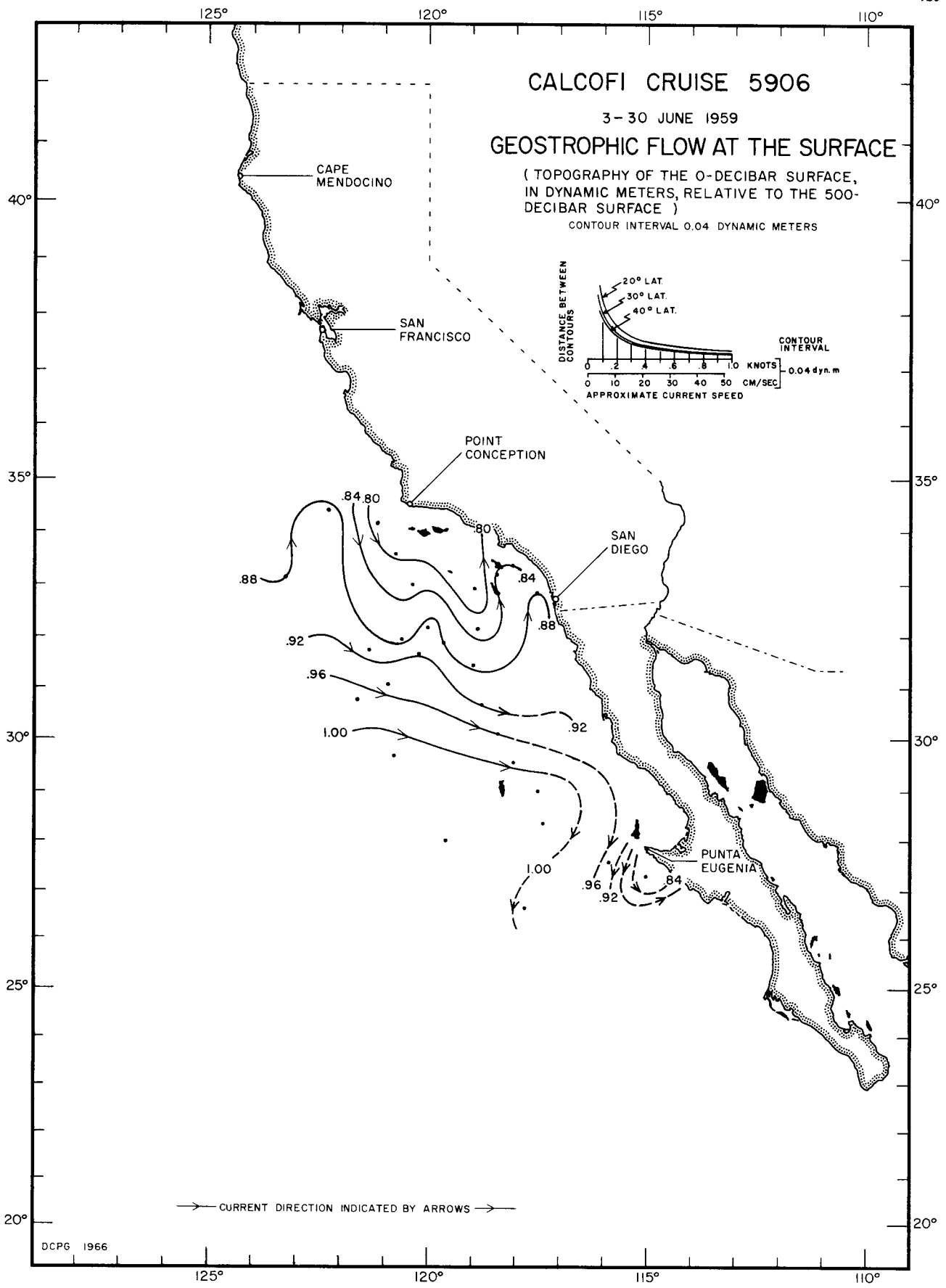


0/500 db  
VERMILION SEA



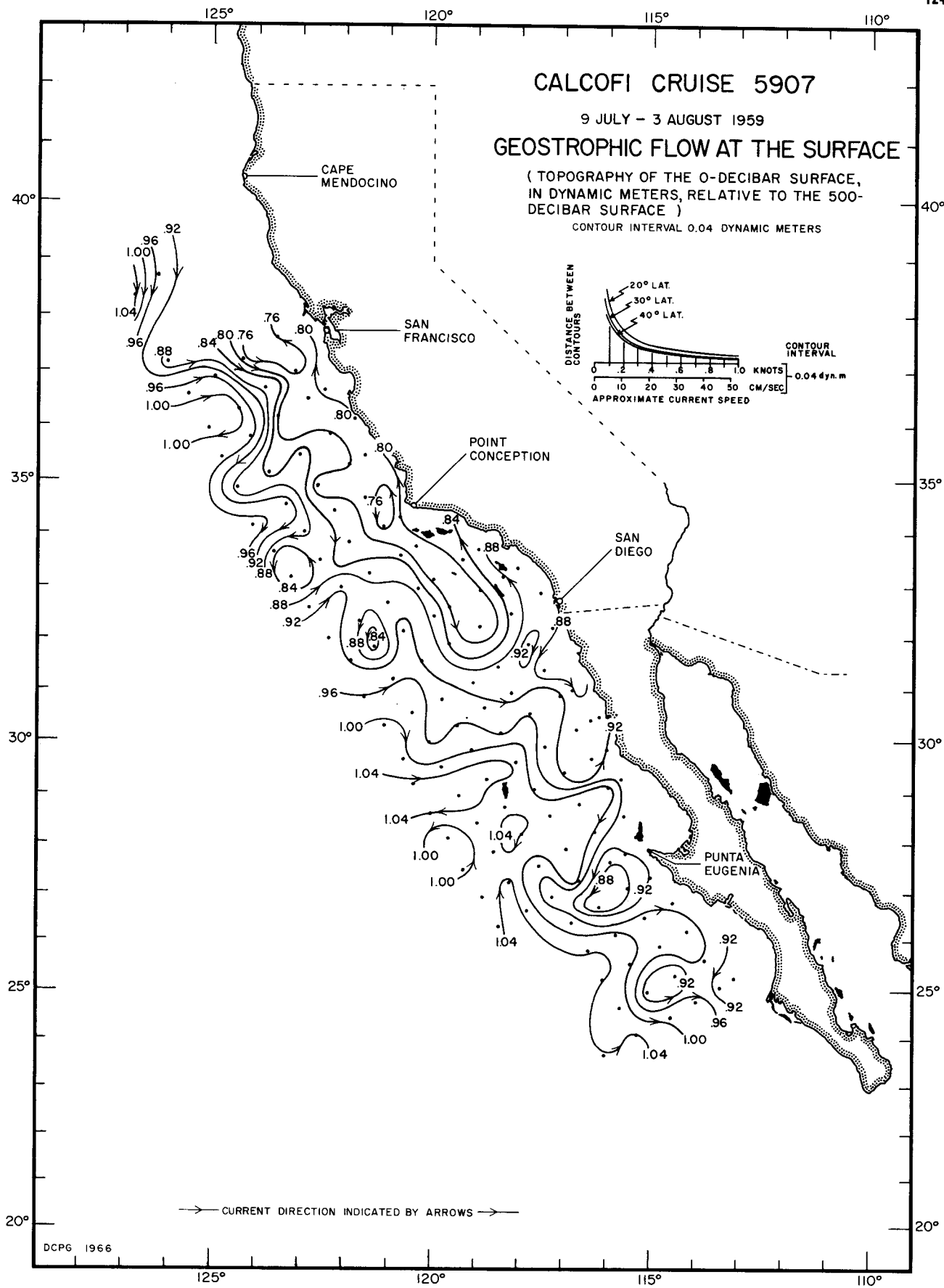
DCPG 1966

O/500 db  
5905

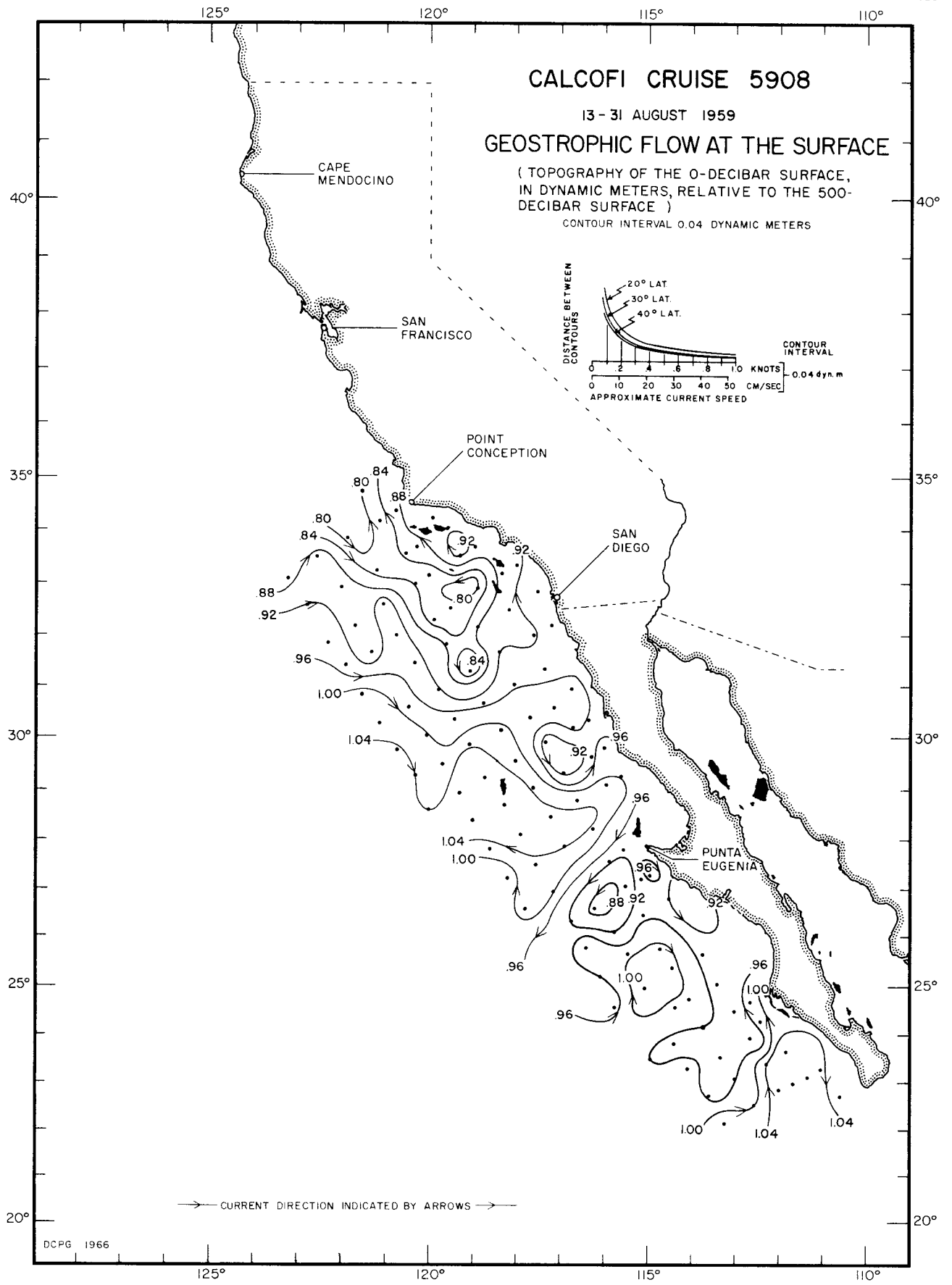


DCP6 1966

O/500 db  
5906

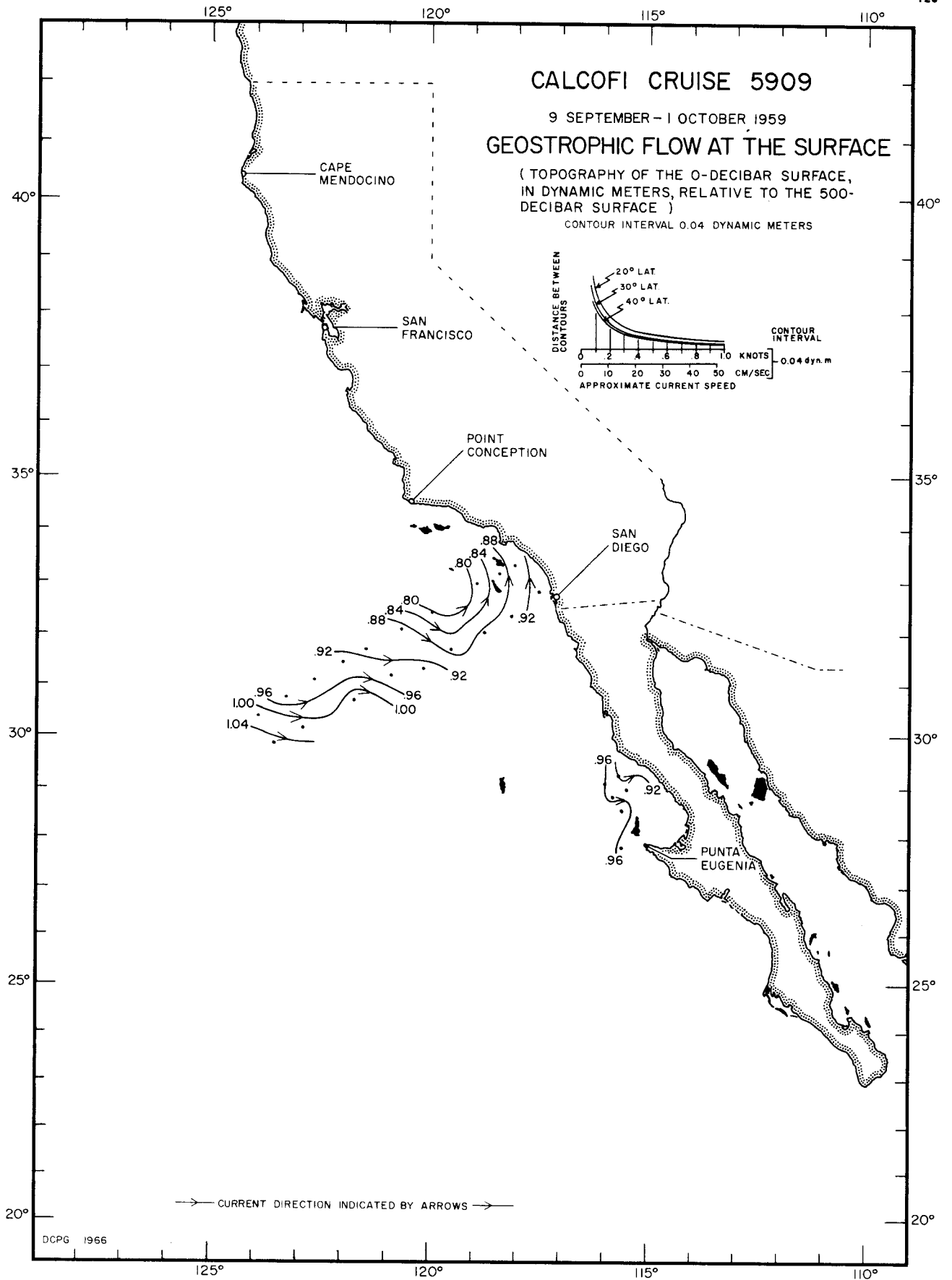


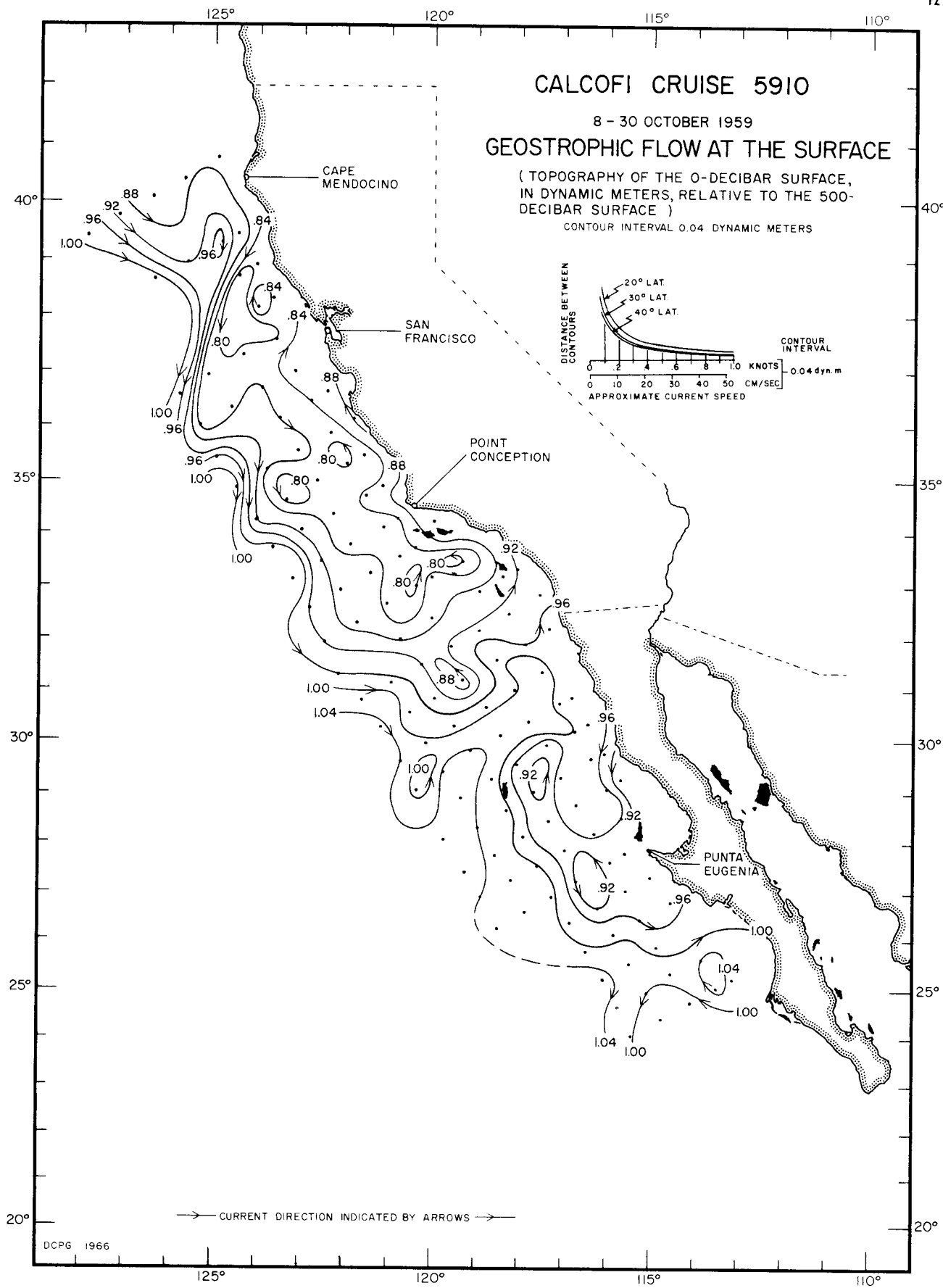
0/500 db  
5907



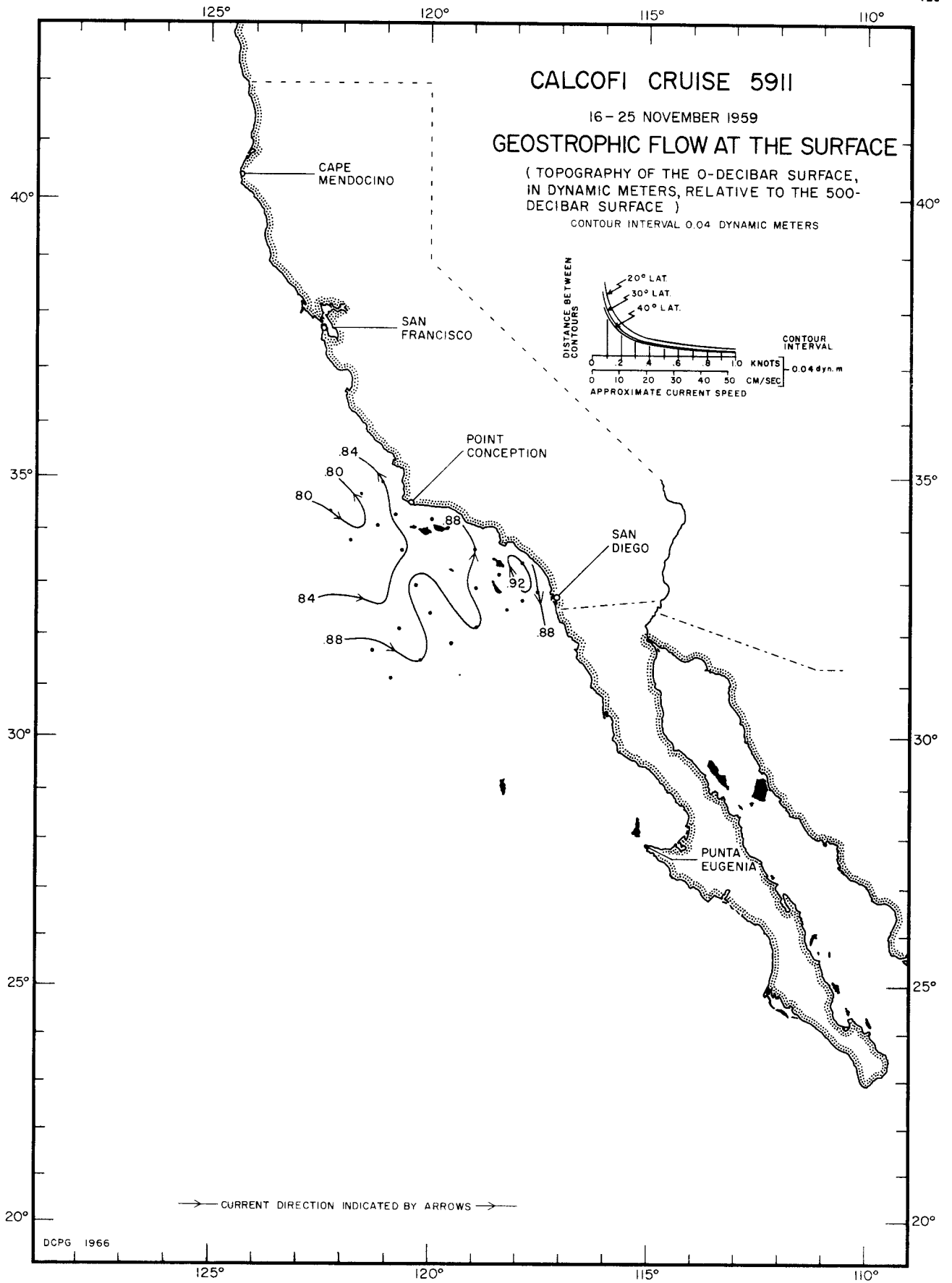
0/500 db  
5908

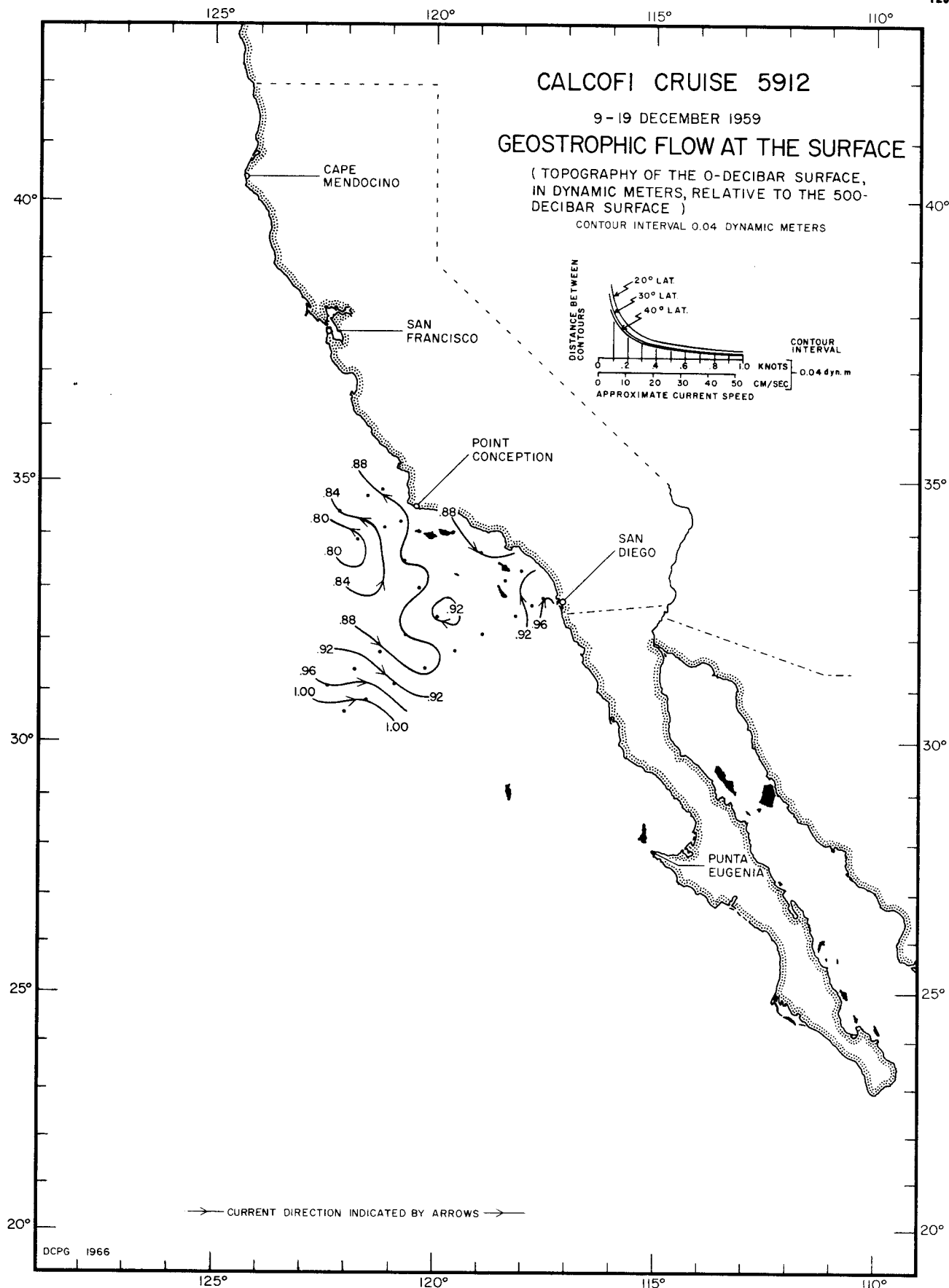




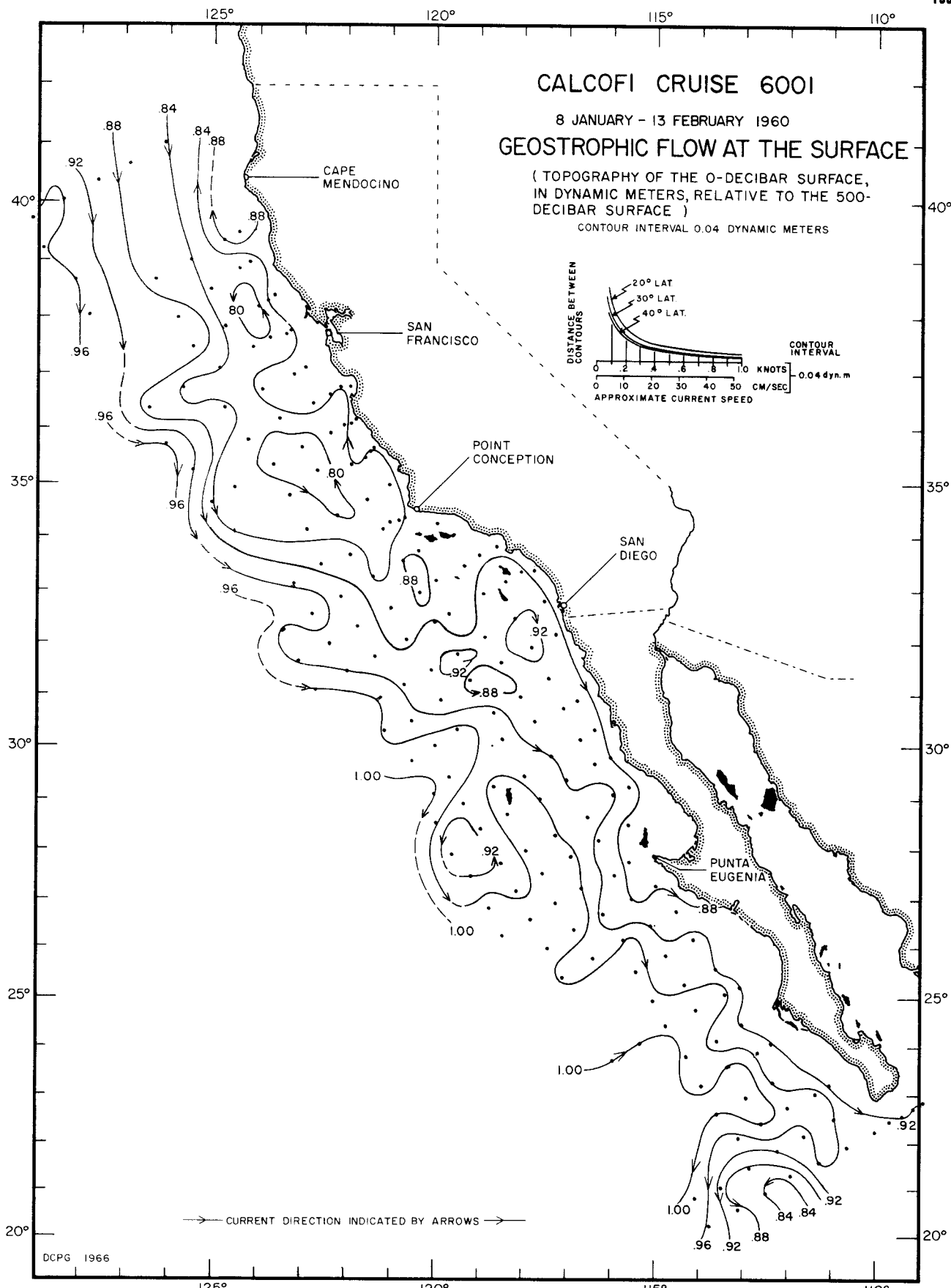


O/500 db  
5910



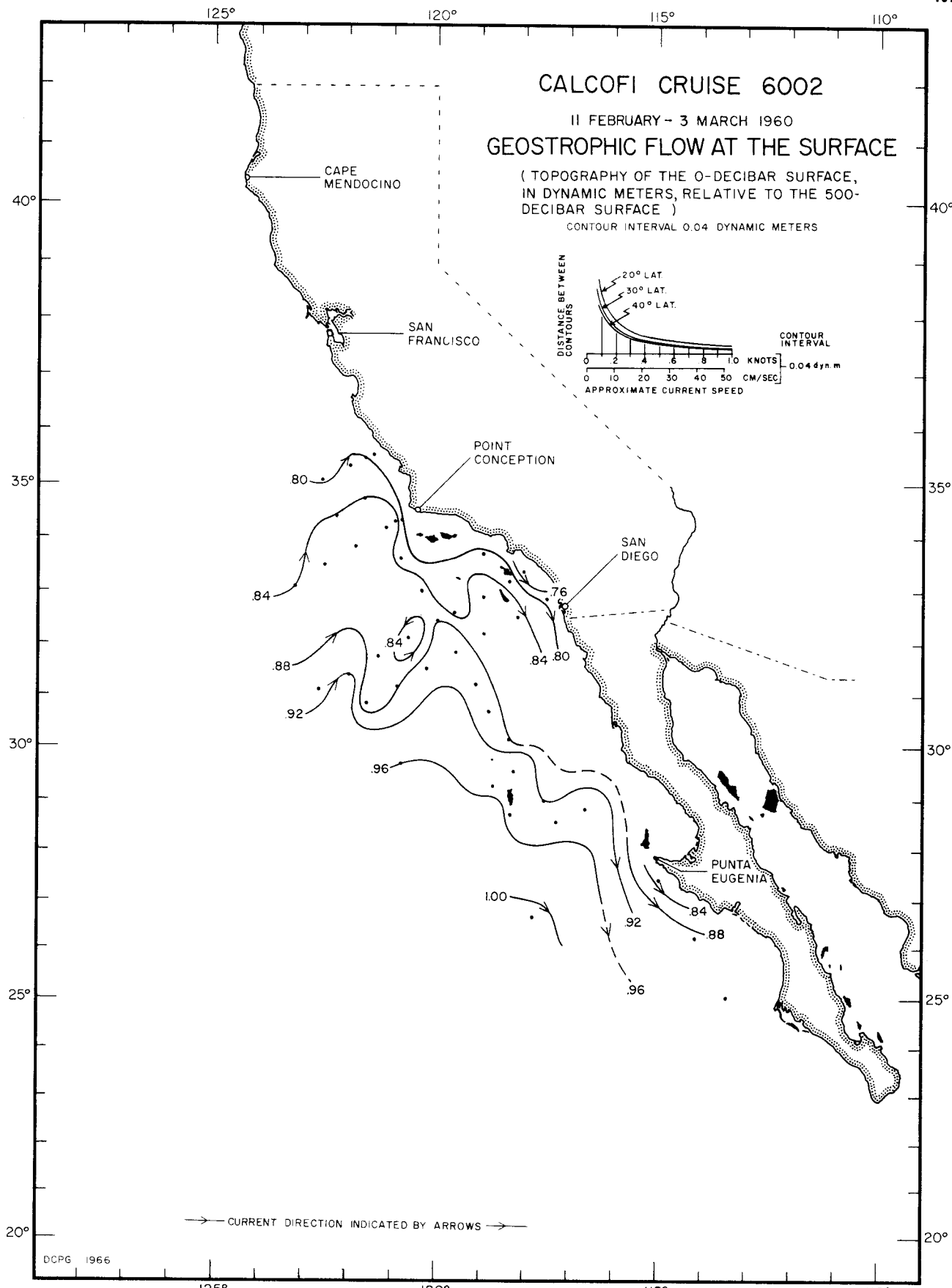


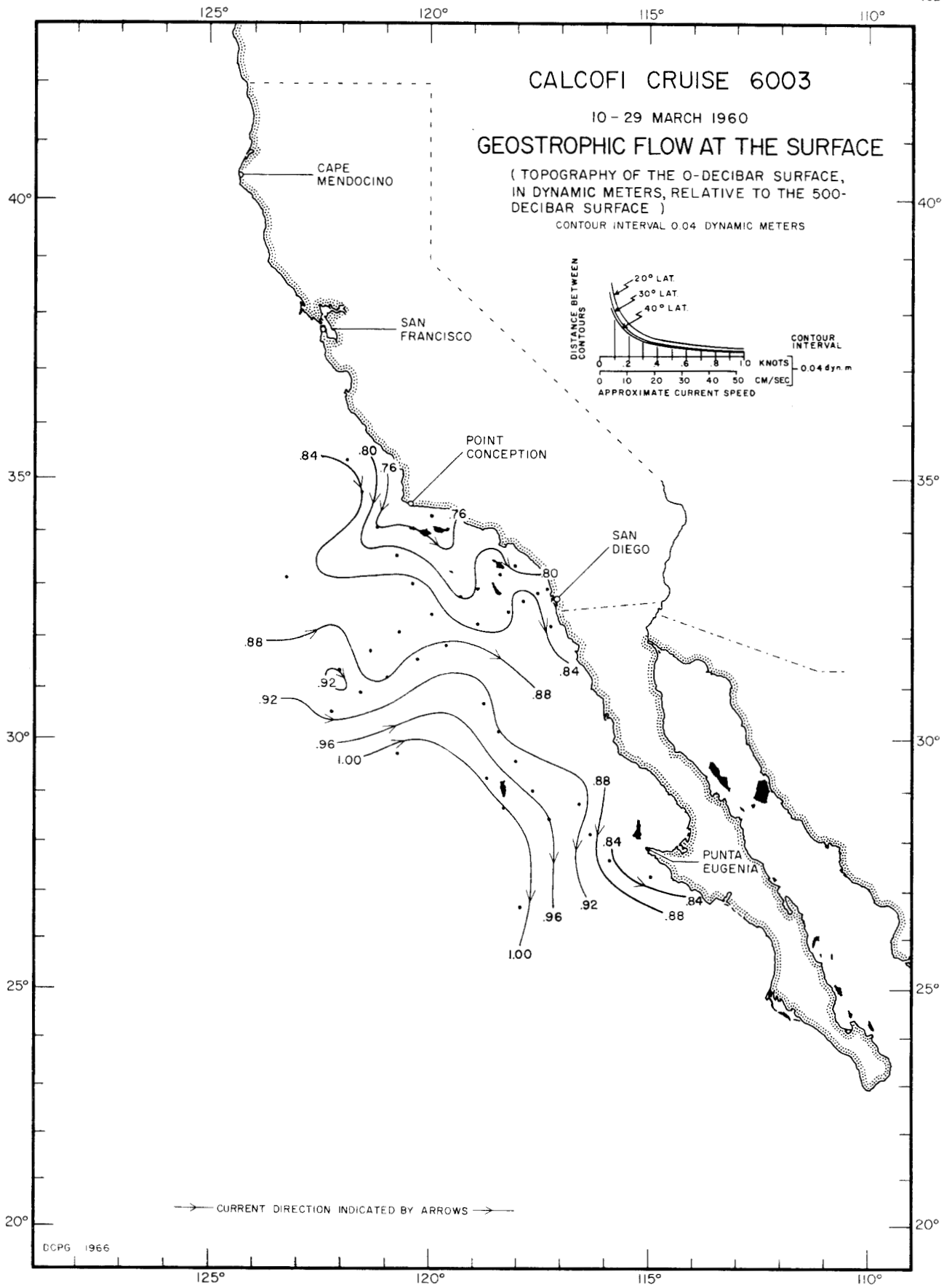
0/500 db  
5912



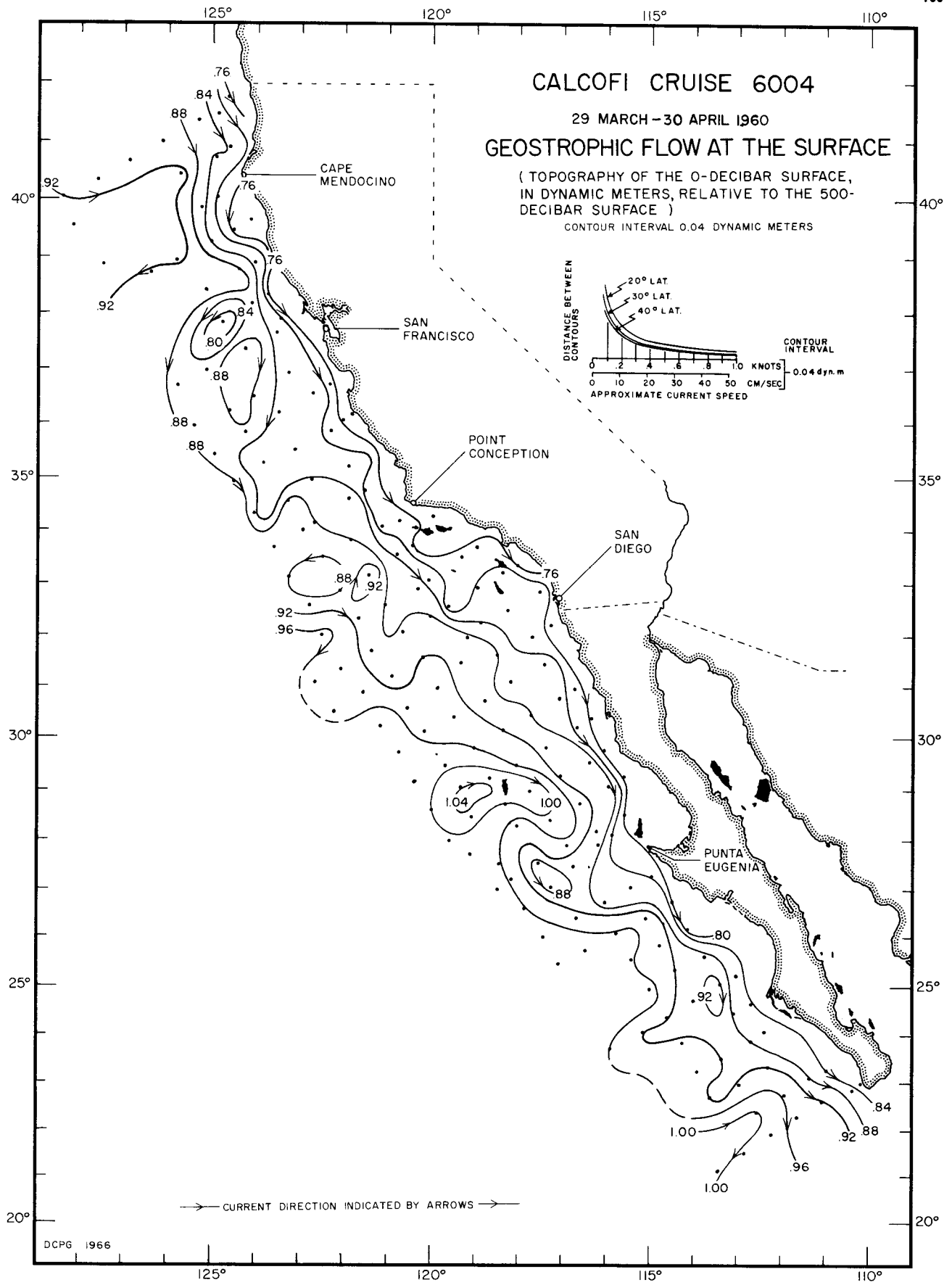
DCPG 1966

O/500 db  
6001

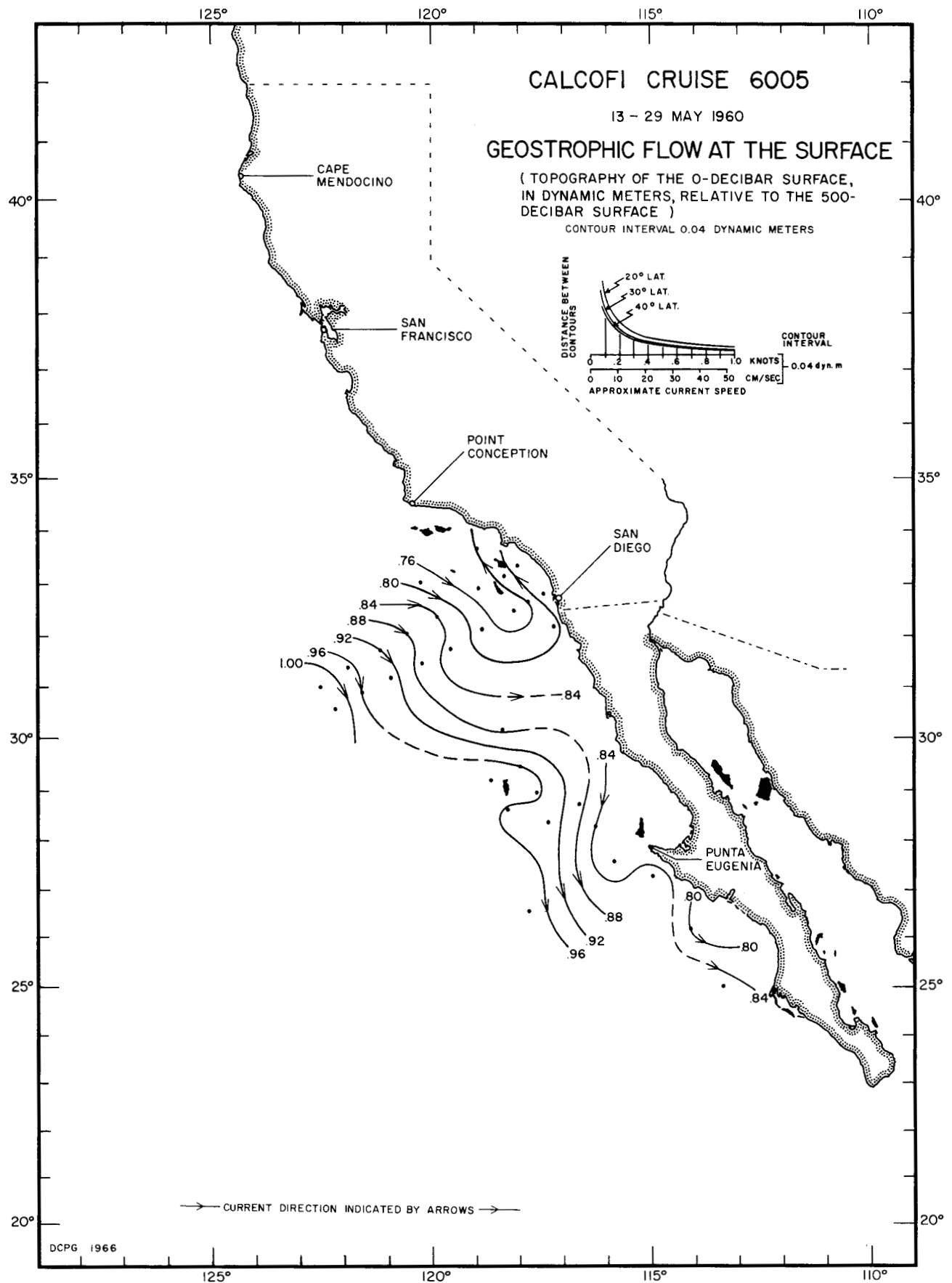




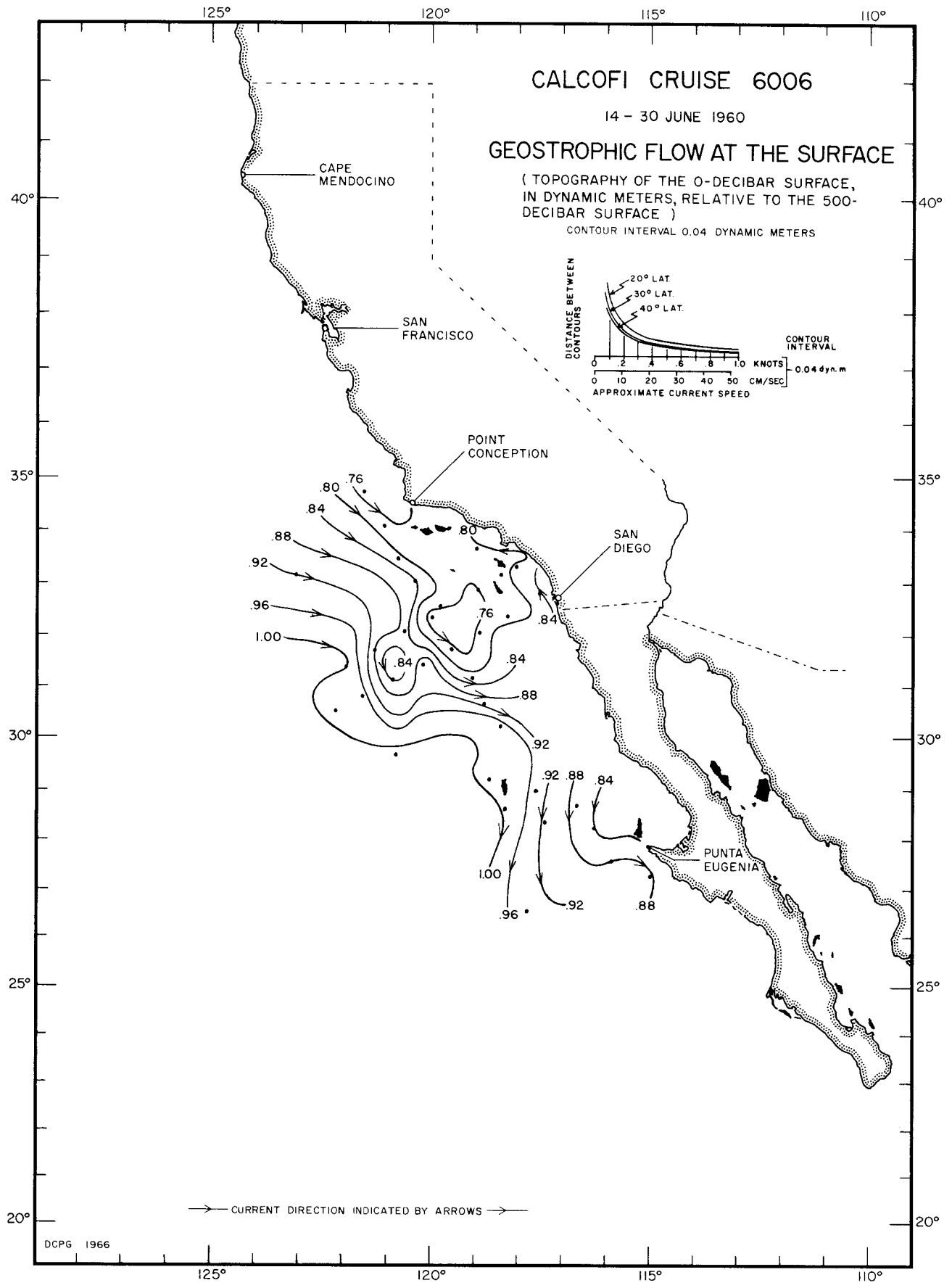
0/500 db  
6003



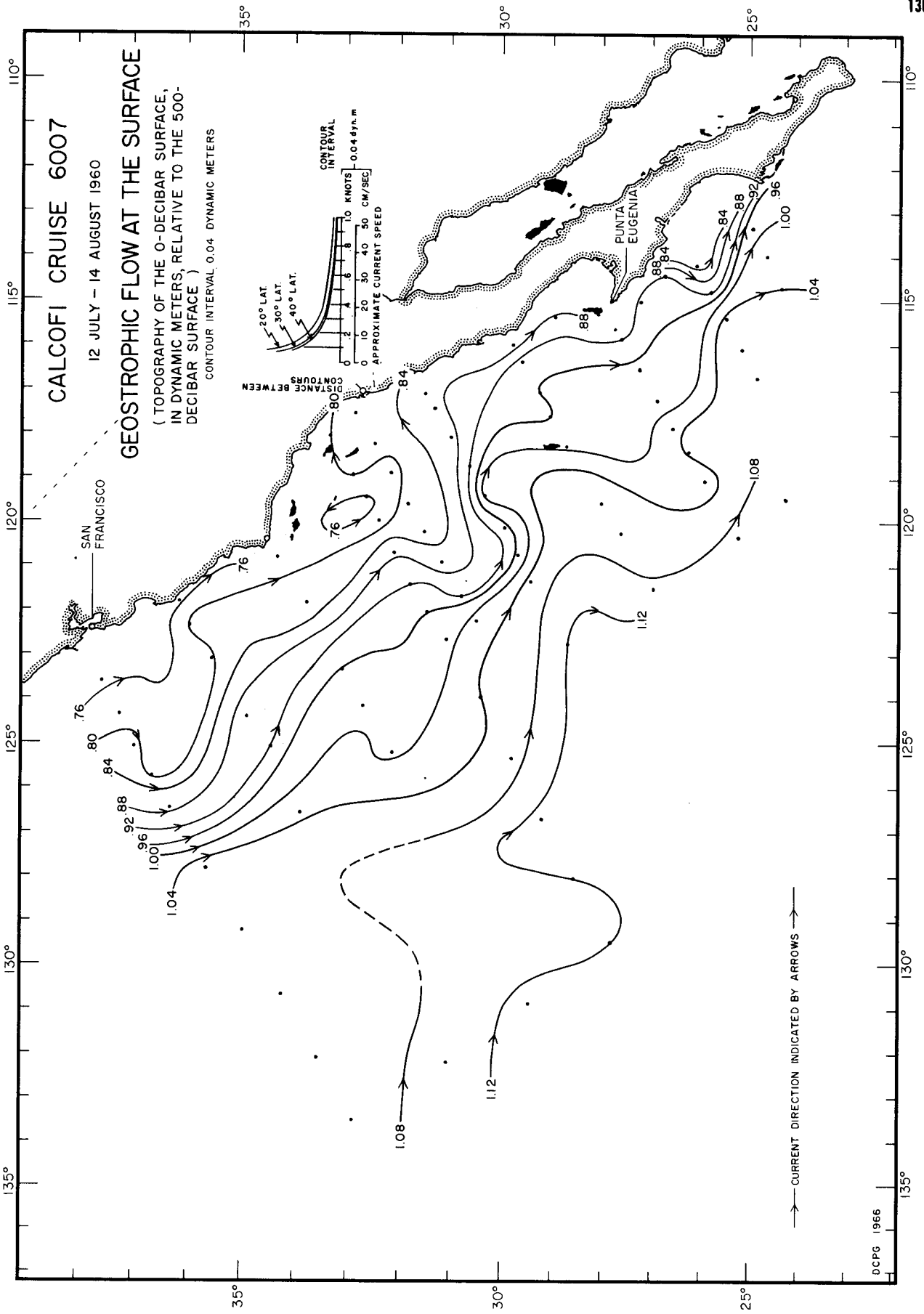




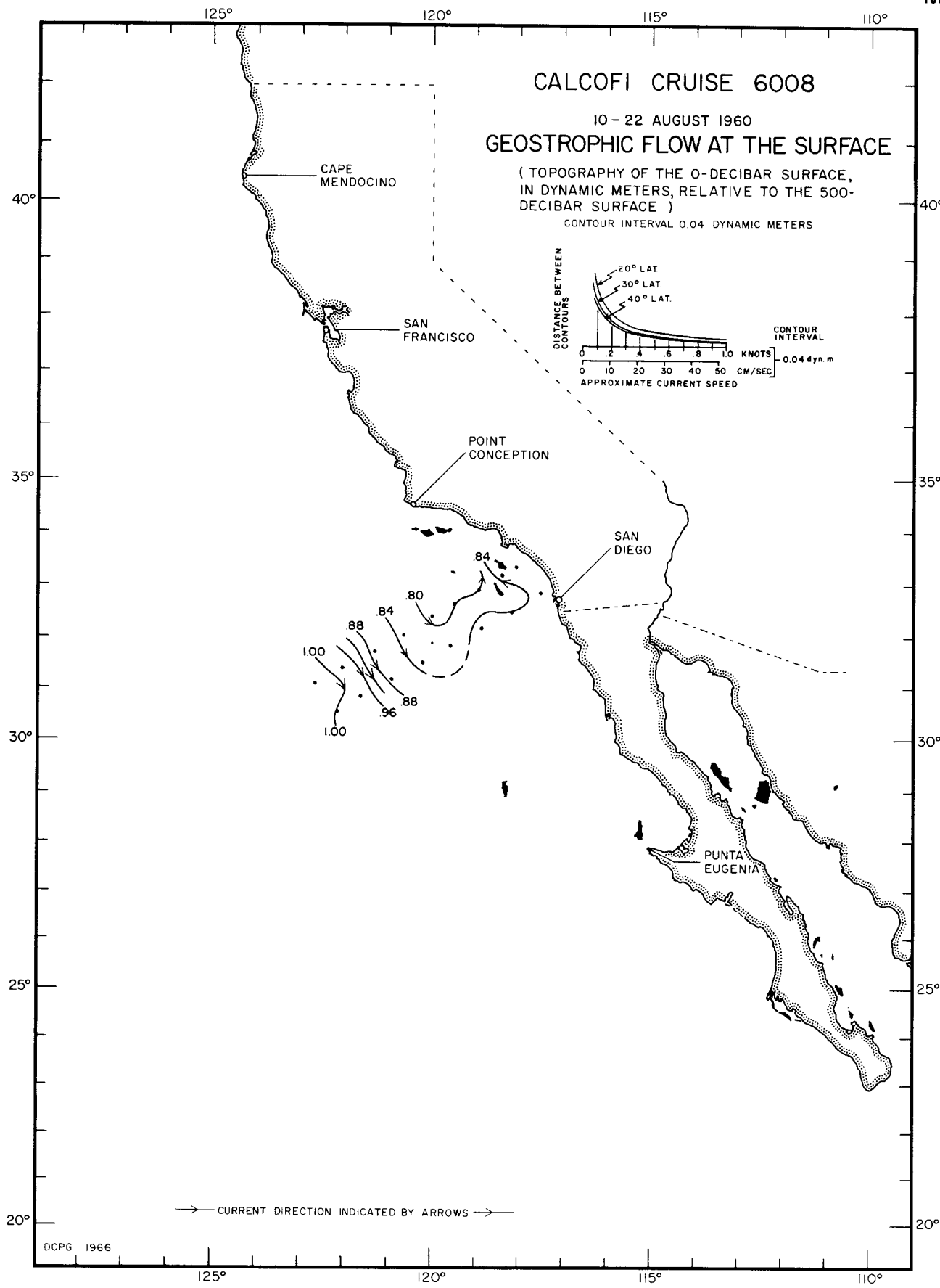
DCPG 1966

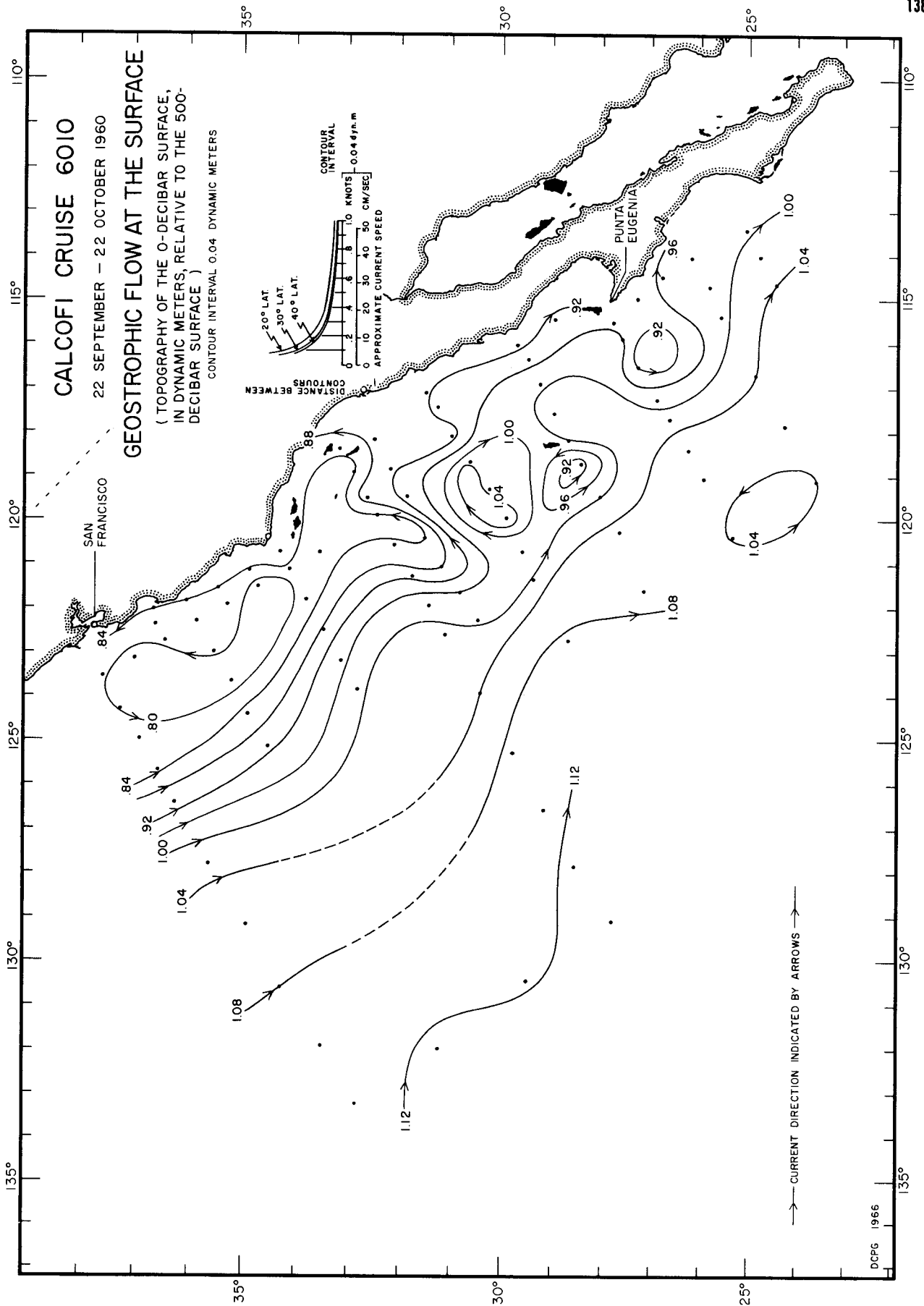


0/500 db  
6006

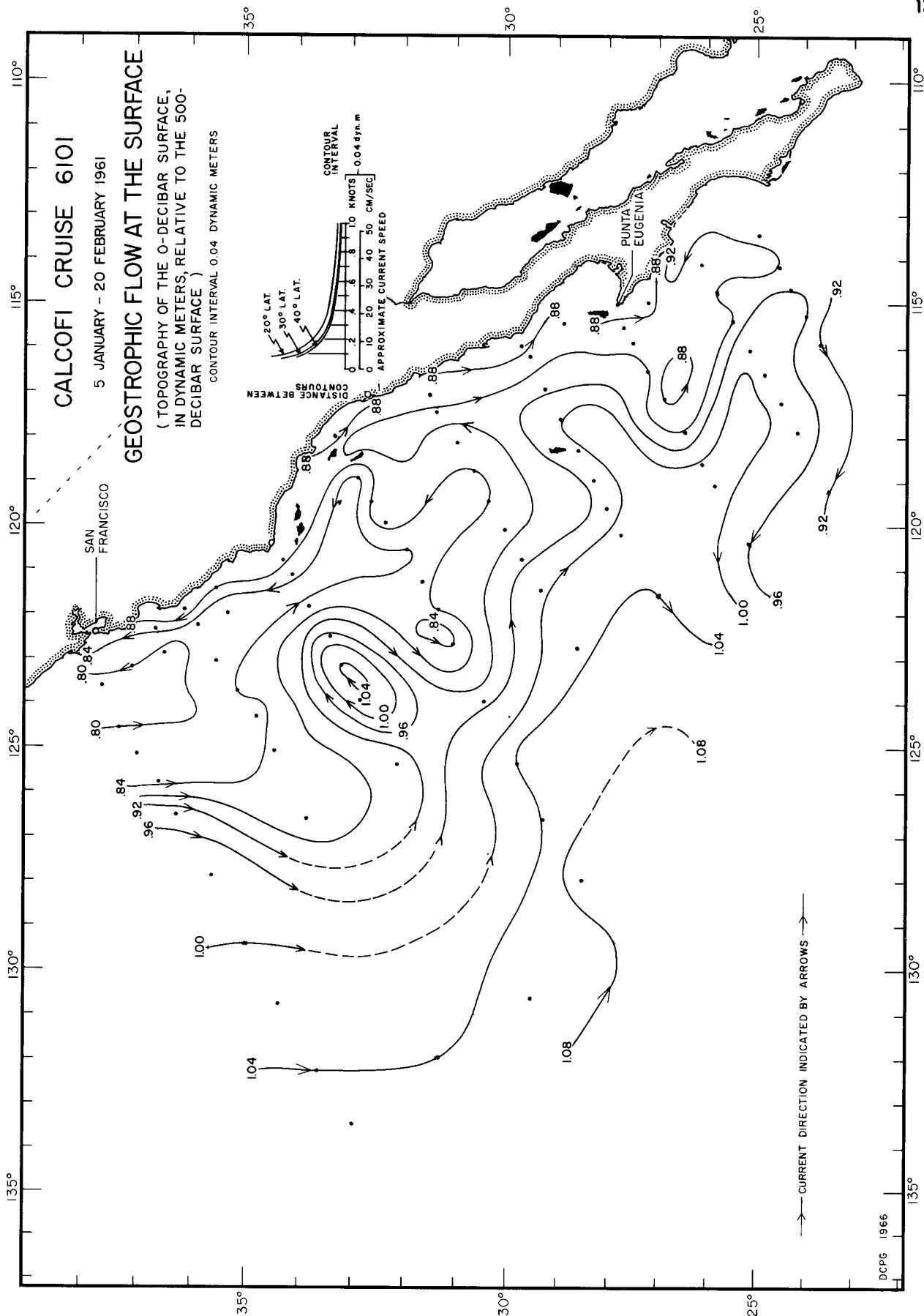


O/500 db  
6007

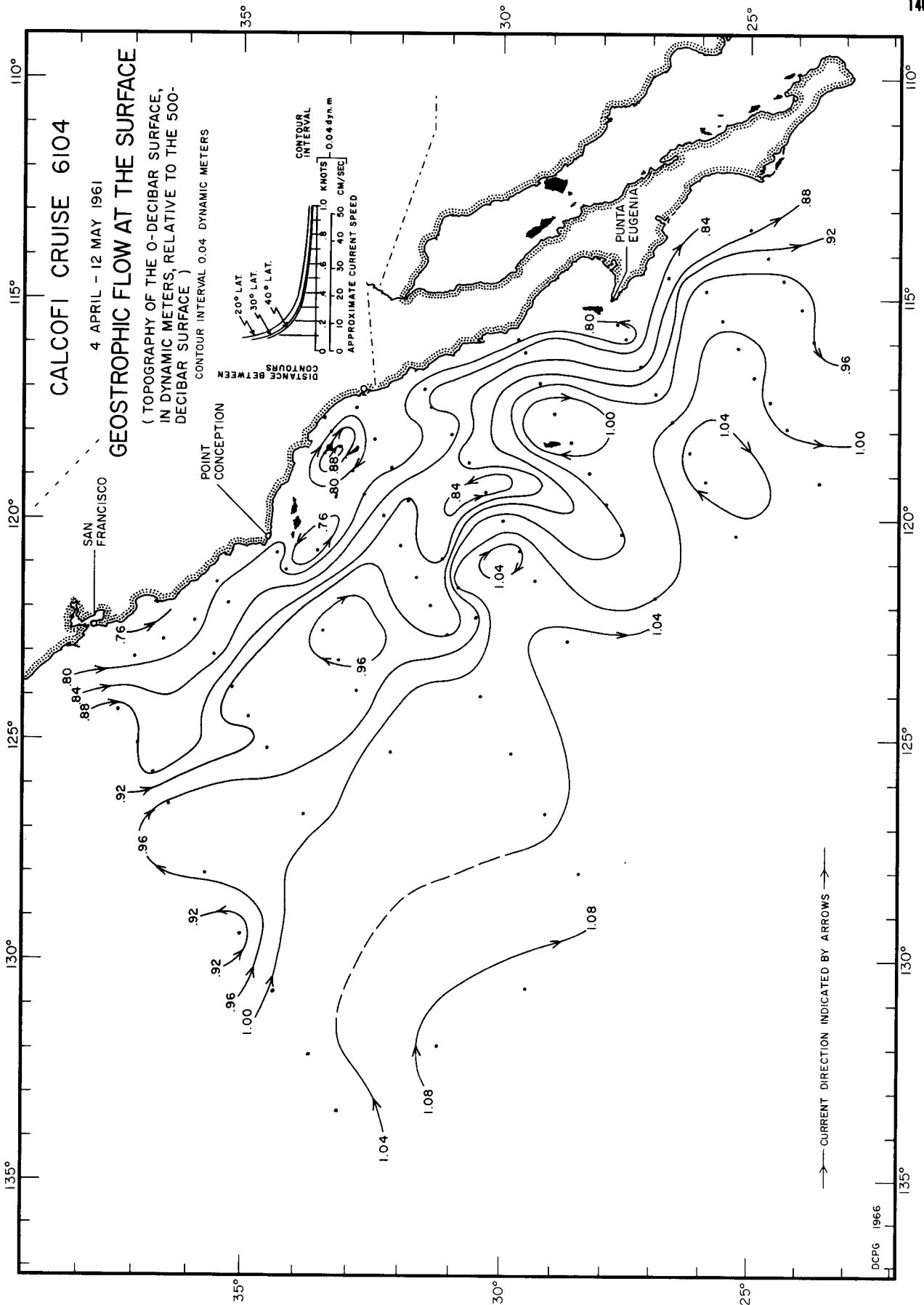




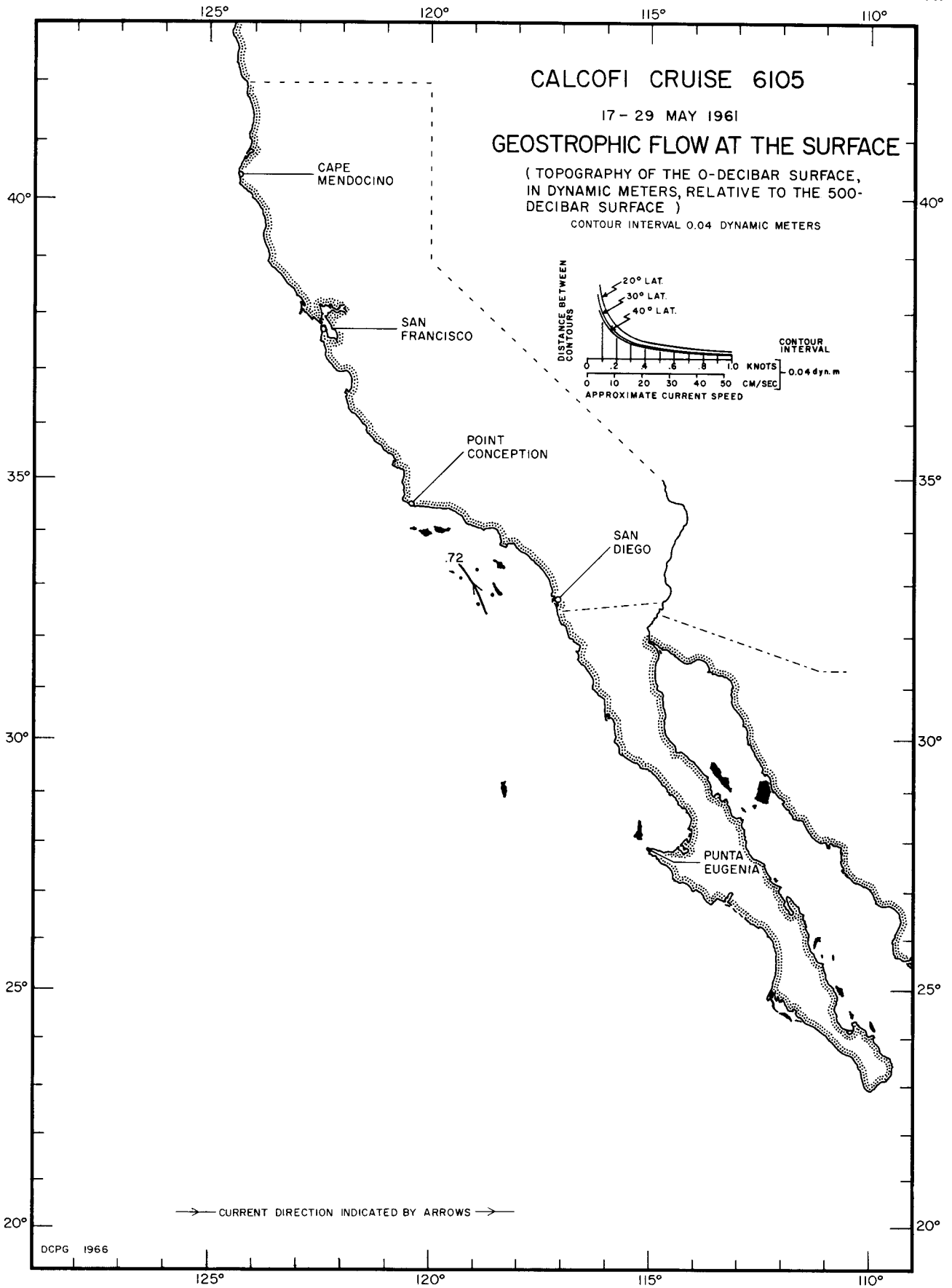
0/500 db  
6010



O/500 db  
6101

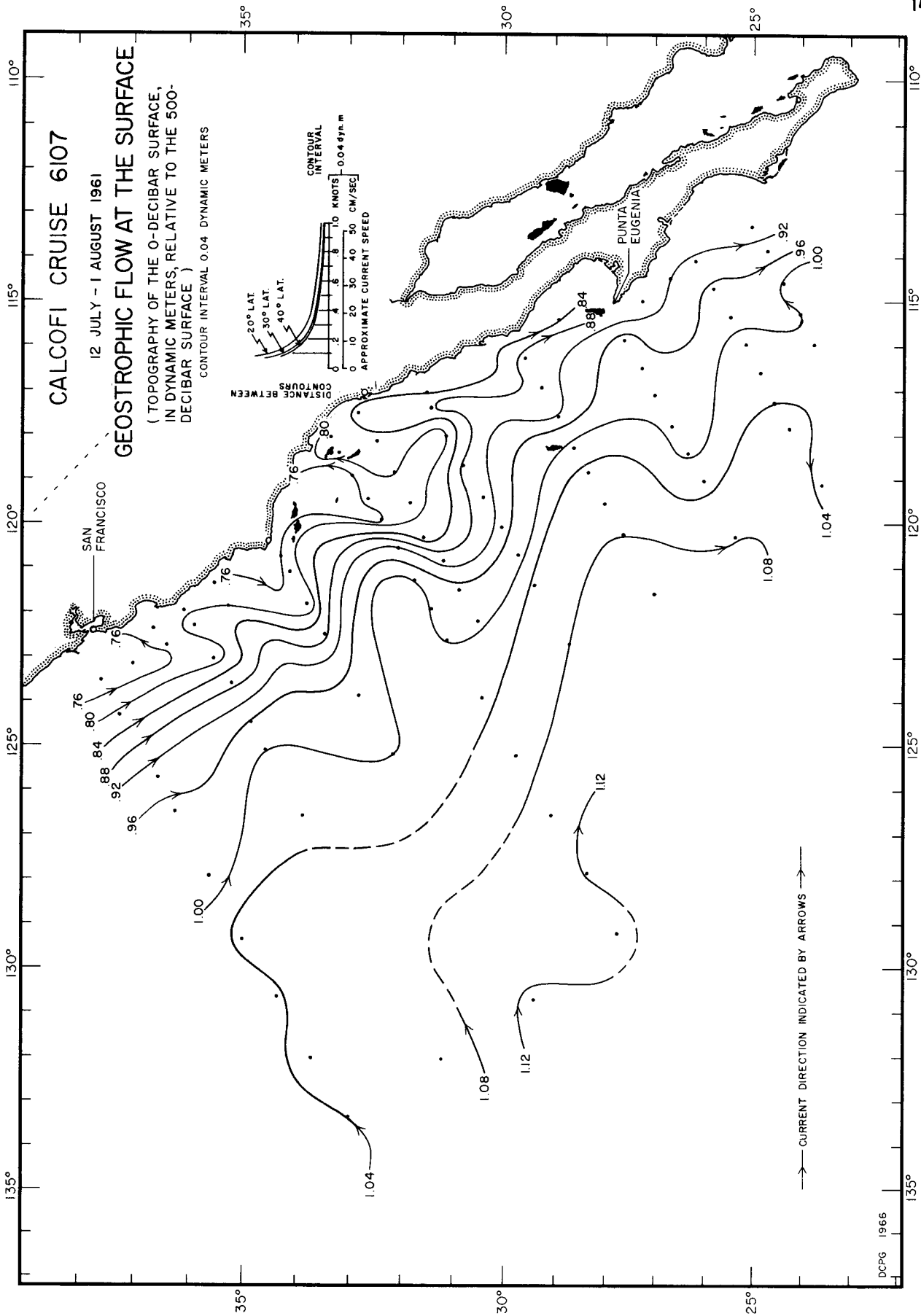


0/500 db  
6104

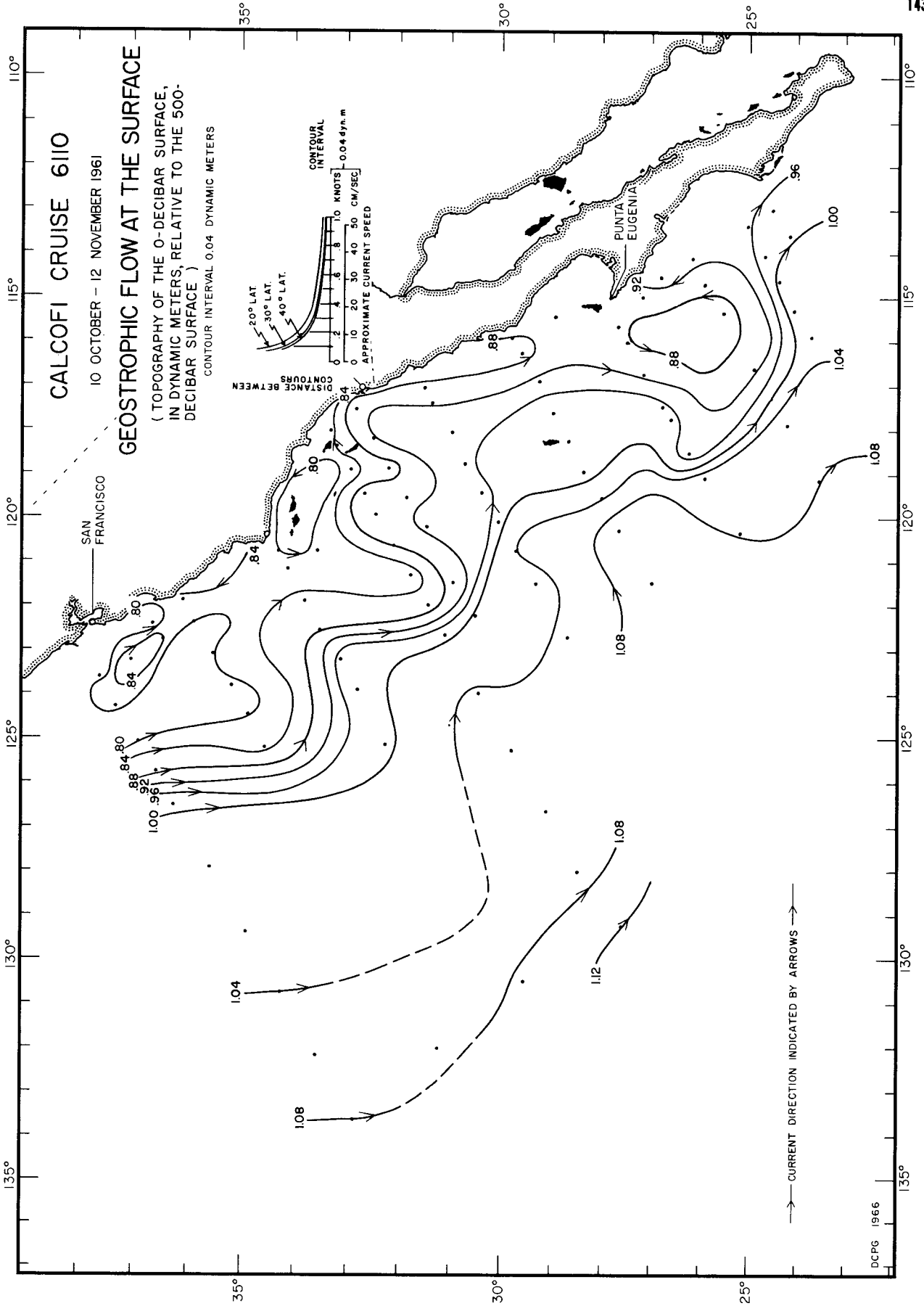


0/500 db  
6105

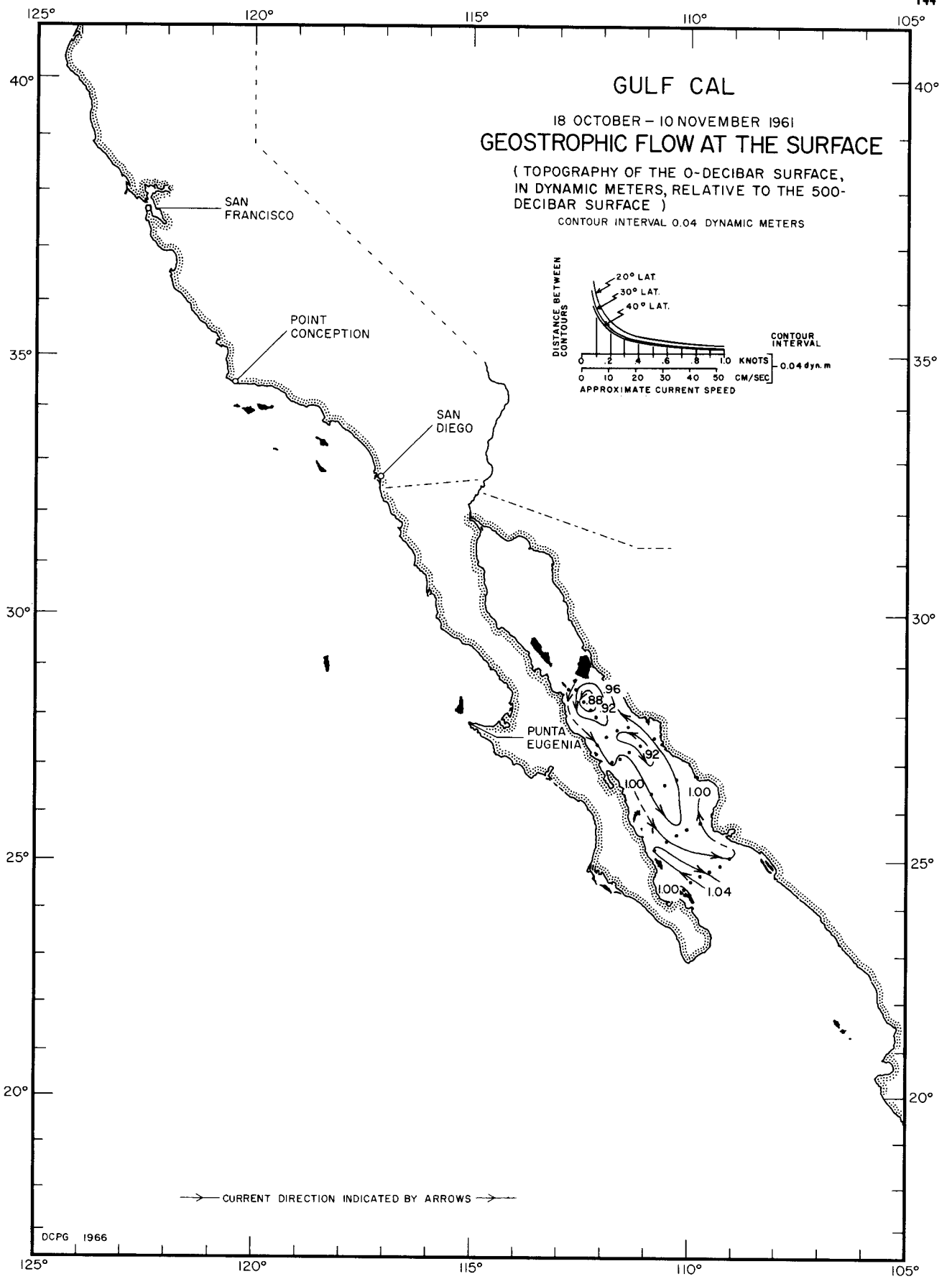




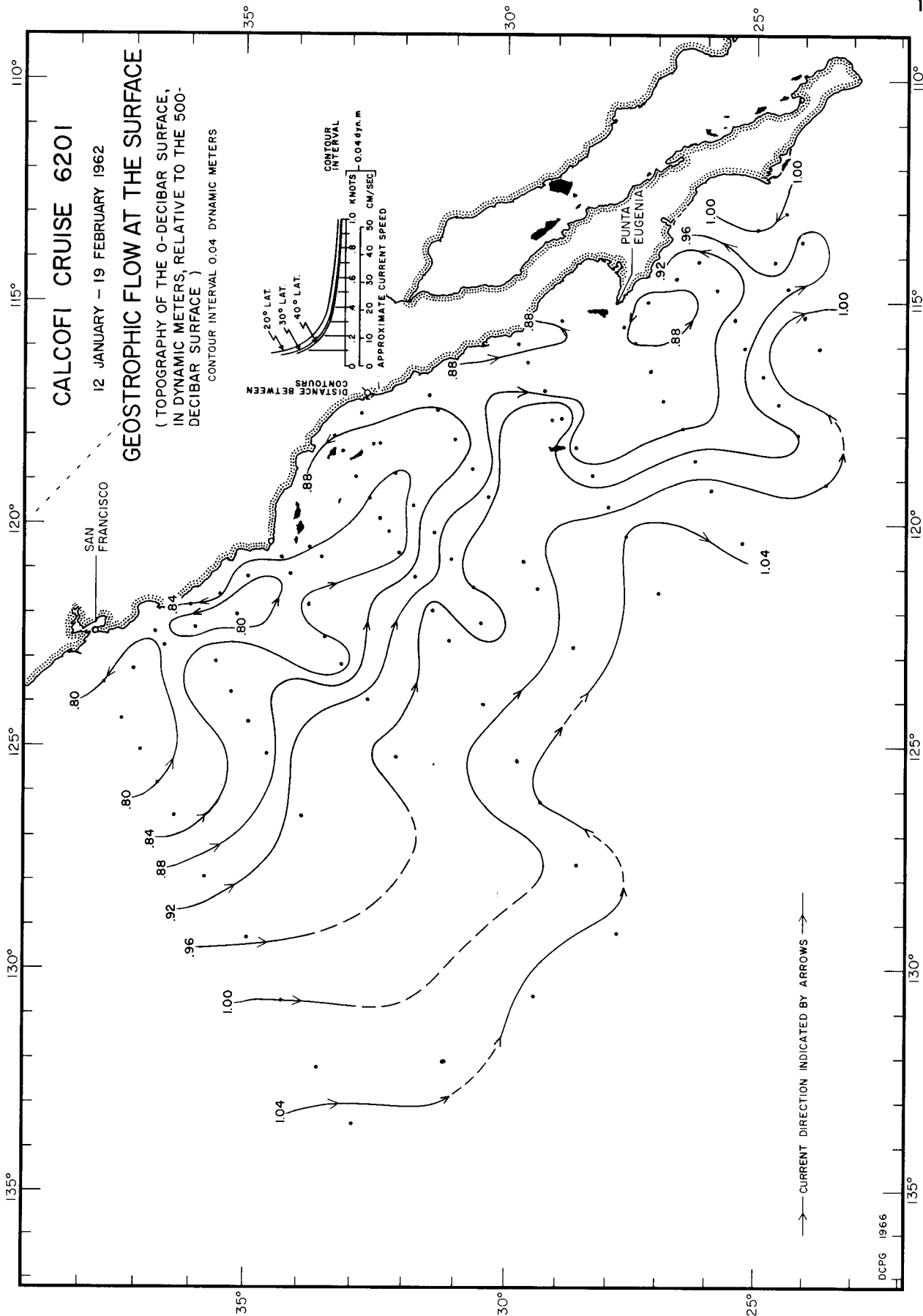
0/500 db  
6107



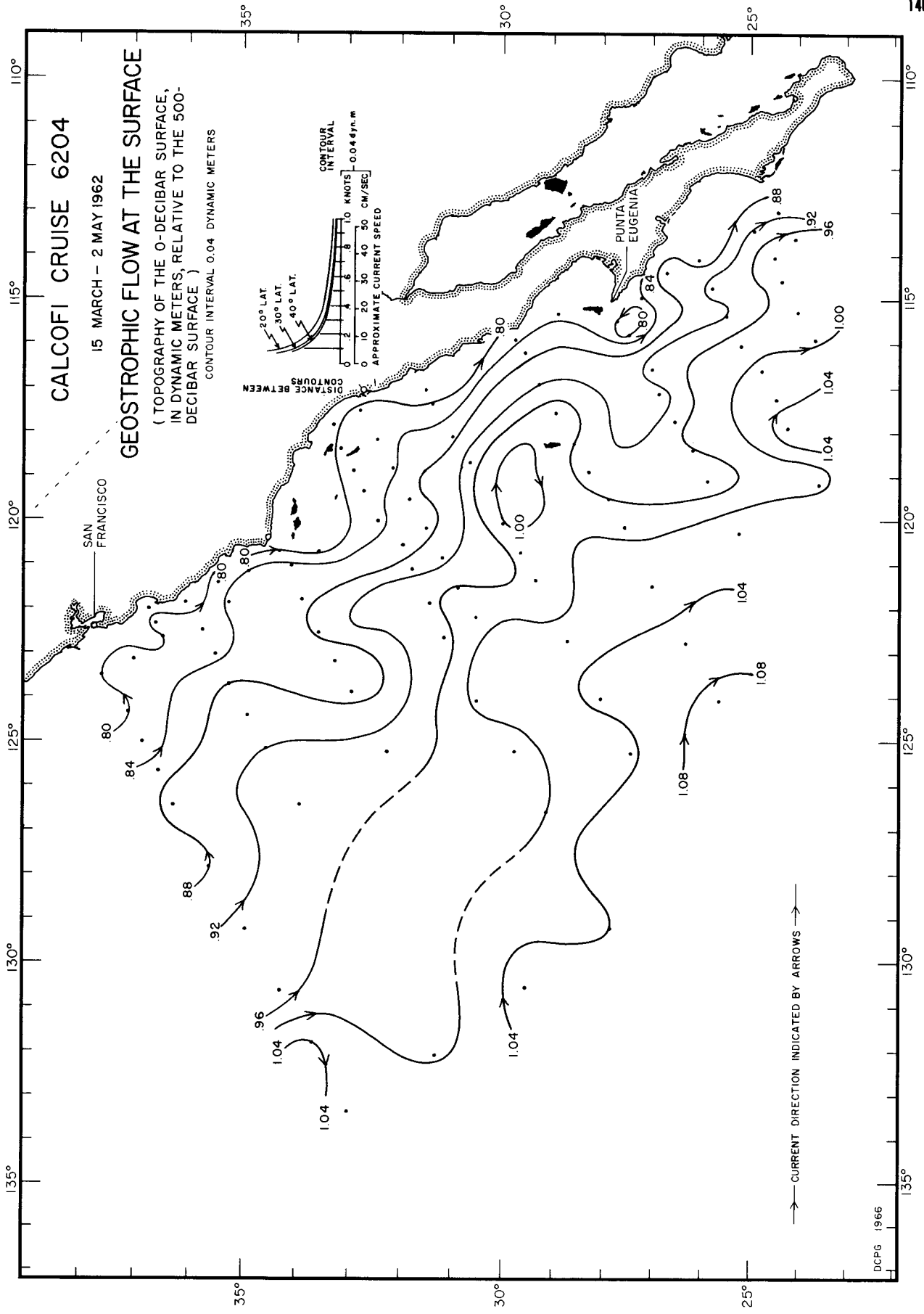
0/500 db  
6110



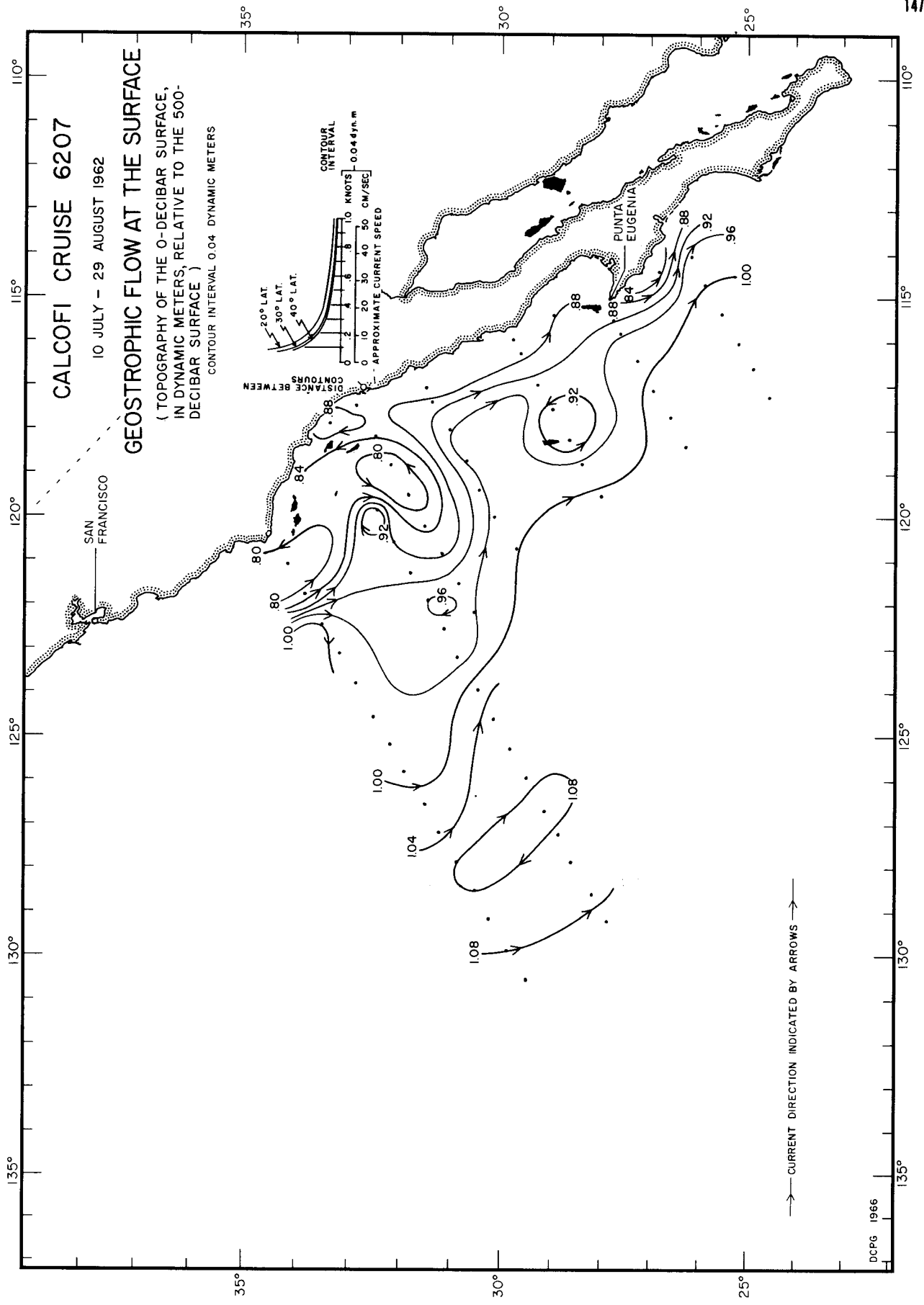
O/500 db  
 GULF CAL



O/500 db  
6201

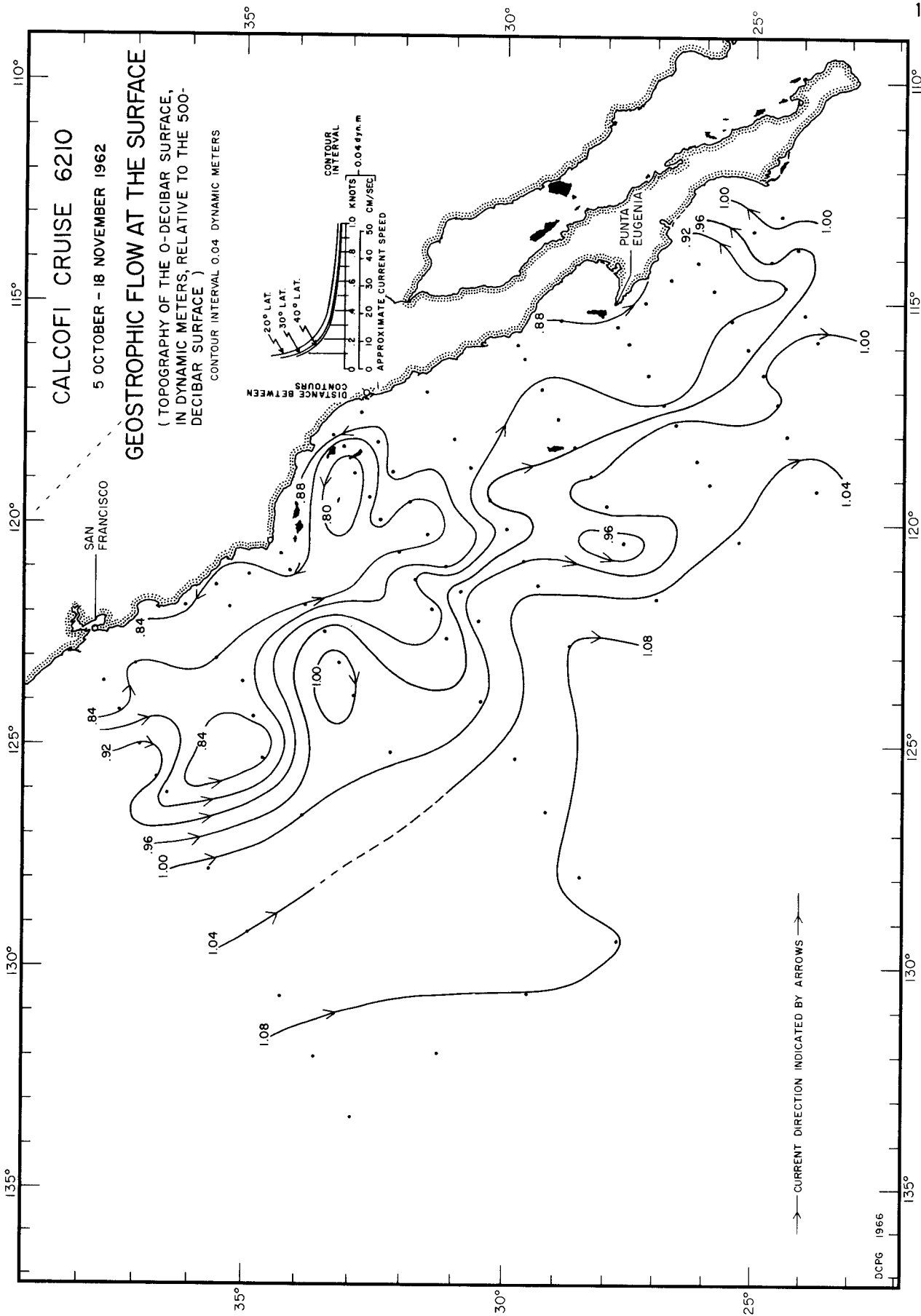


O/500 db  
6204

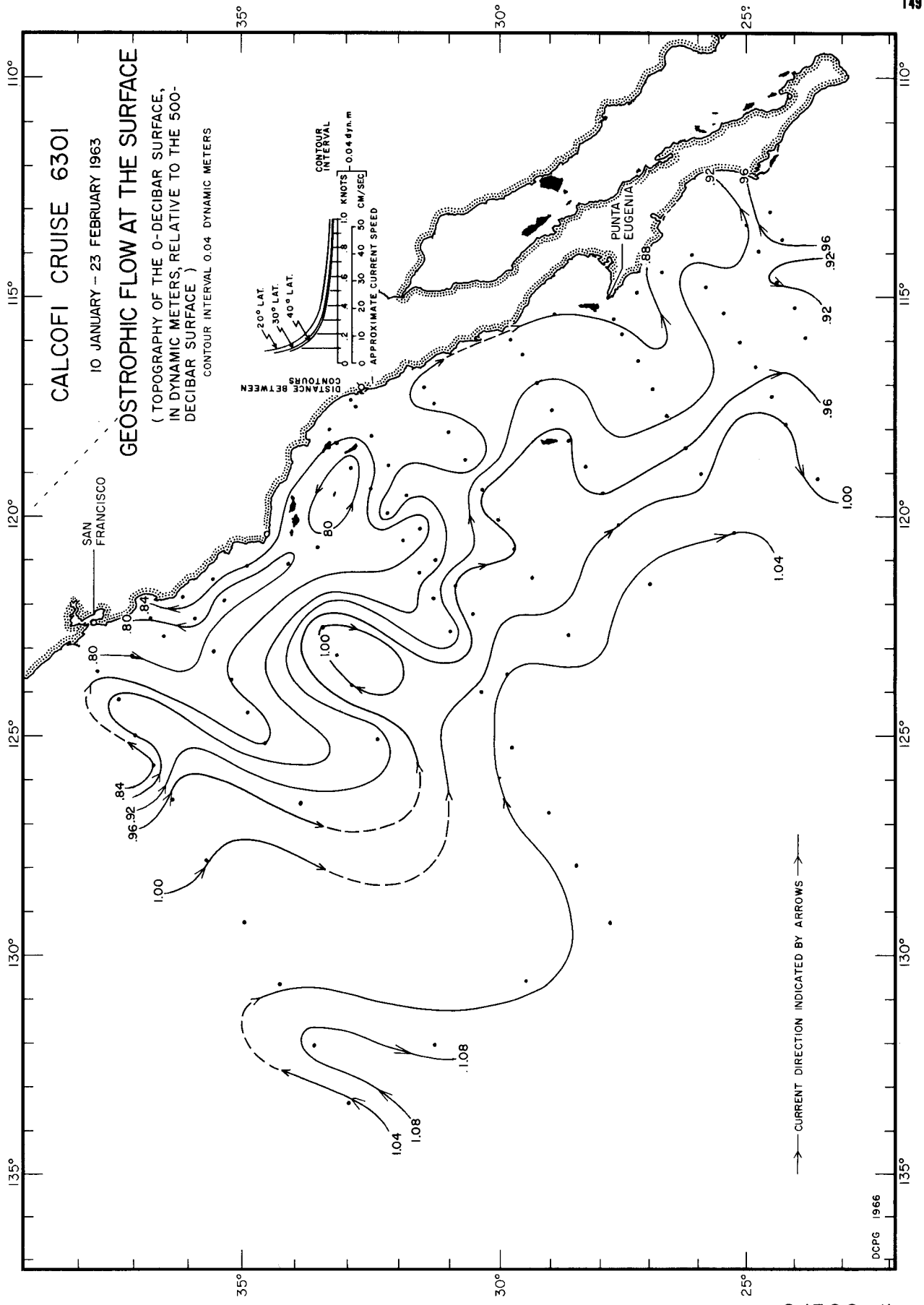


O/500 db  
6207

DCPG 1966



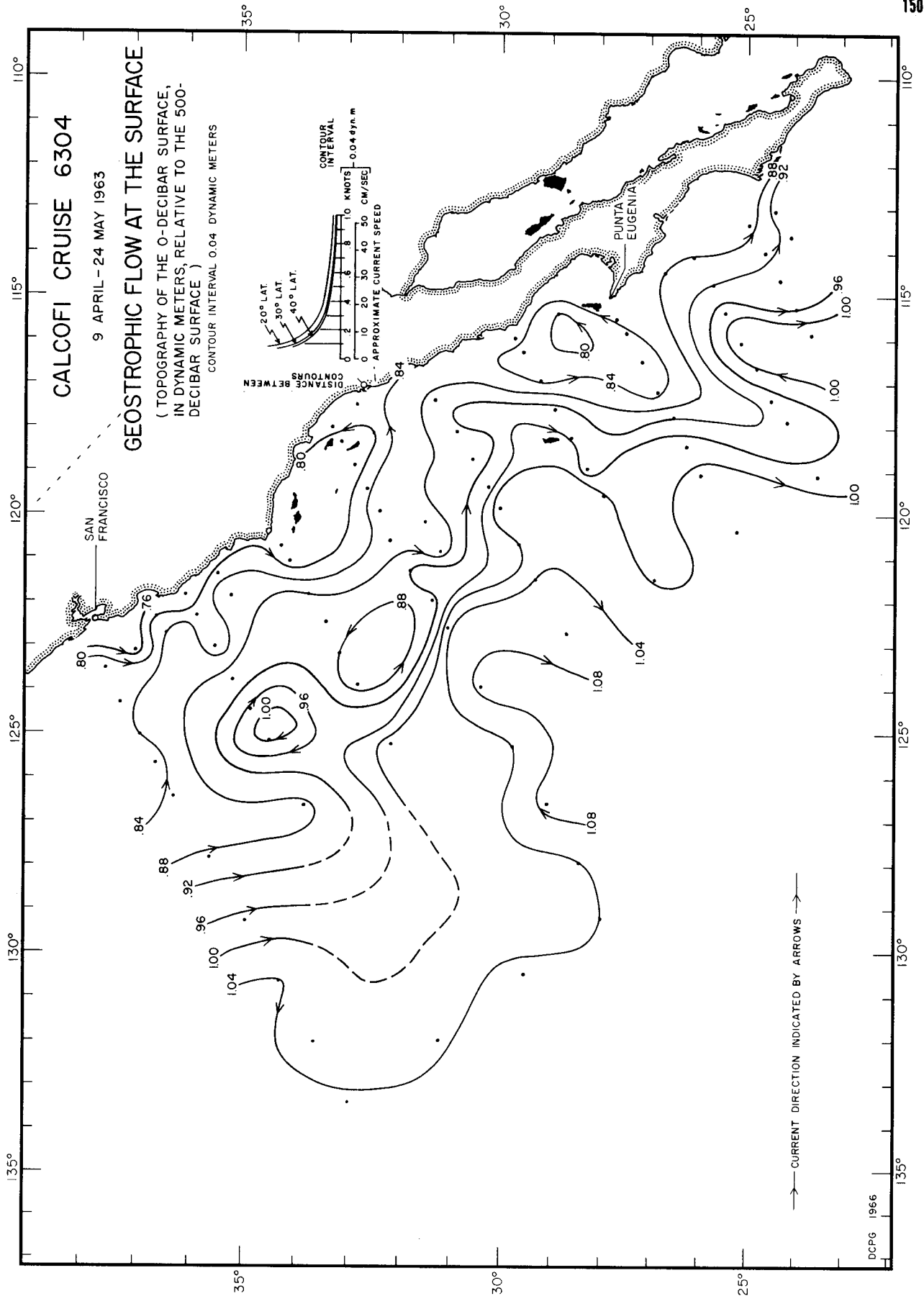
O/500 db  
6210



DCP6 1966

O/500 db  
6301





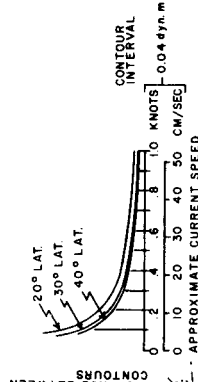
# CALCOFI CRUISE 6304

9 APRIL - 24 MAY 1963

## GEOSTROPHIC FLOW AT THE SURFACE

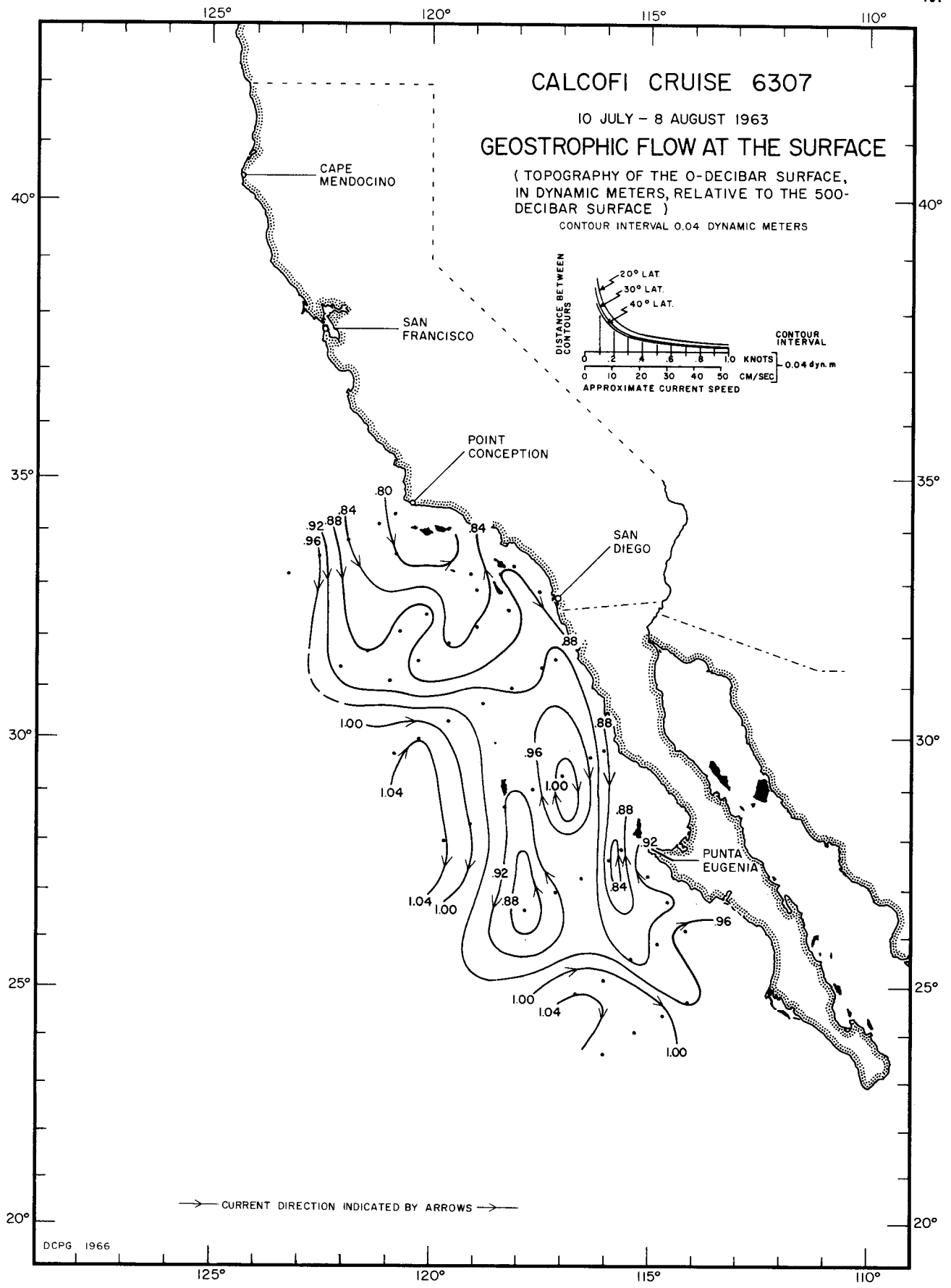
( TOPOGRAPHY OF THE 0-DECIBAR SURFACE,  
IN DYNAMIC METERS, RELATIVE TO THE 500-  
DECIBAR SURFACE )

CONTOUR INTERVAL 0.04 DYNAMIC METERS

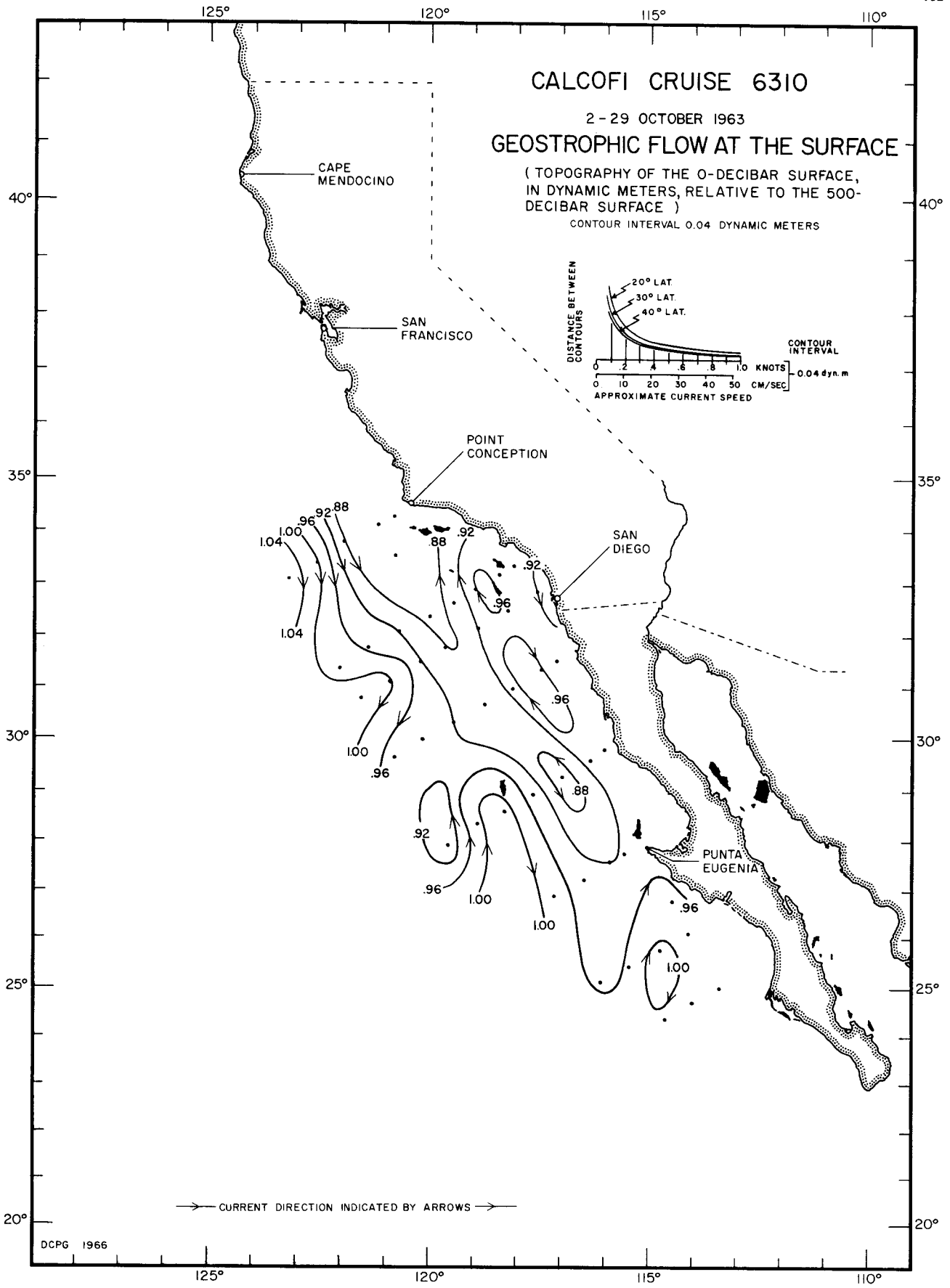


O/500 db  
6304

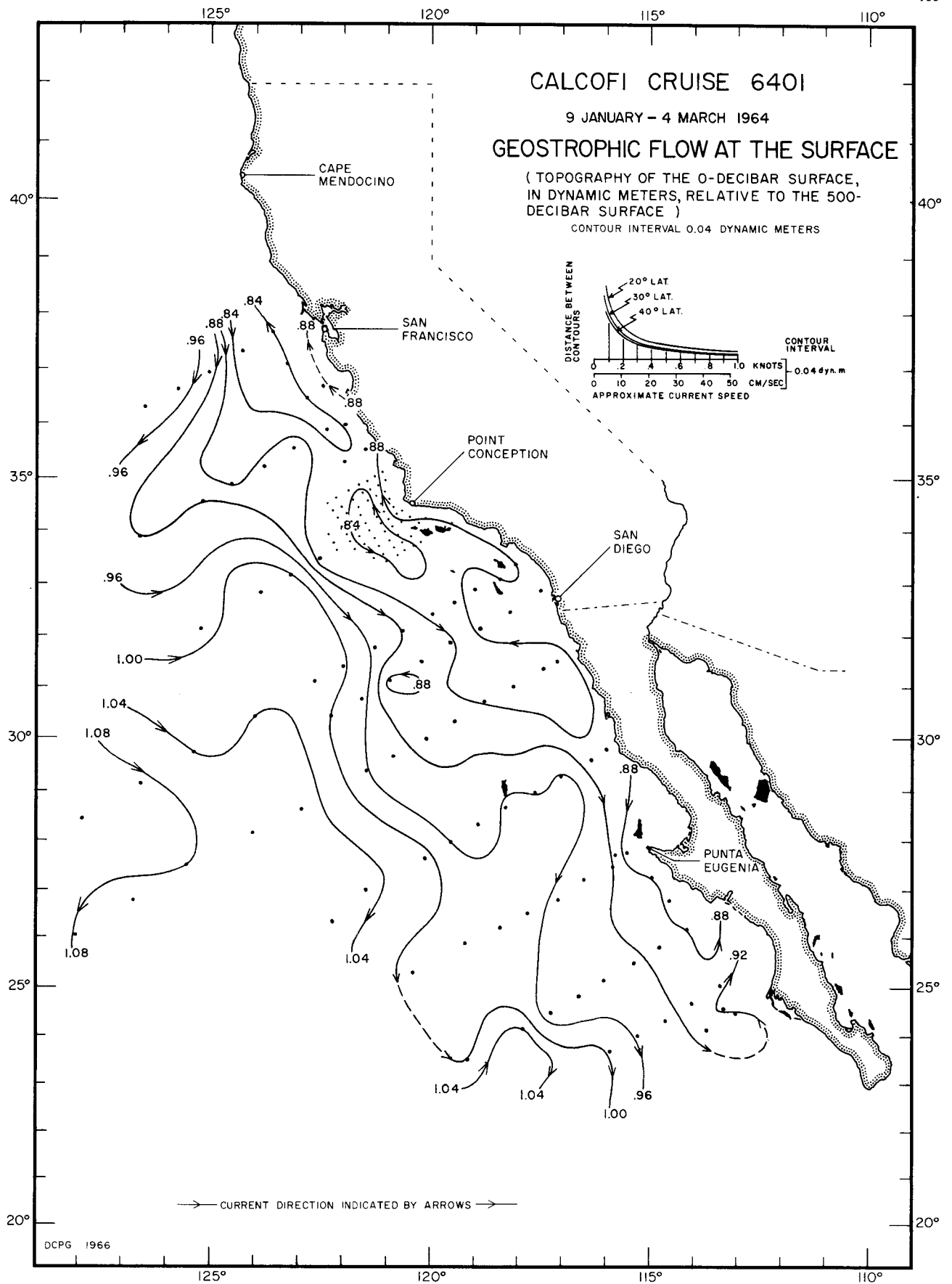
DCPG 1966



0/500 db  
6307

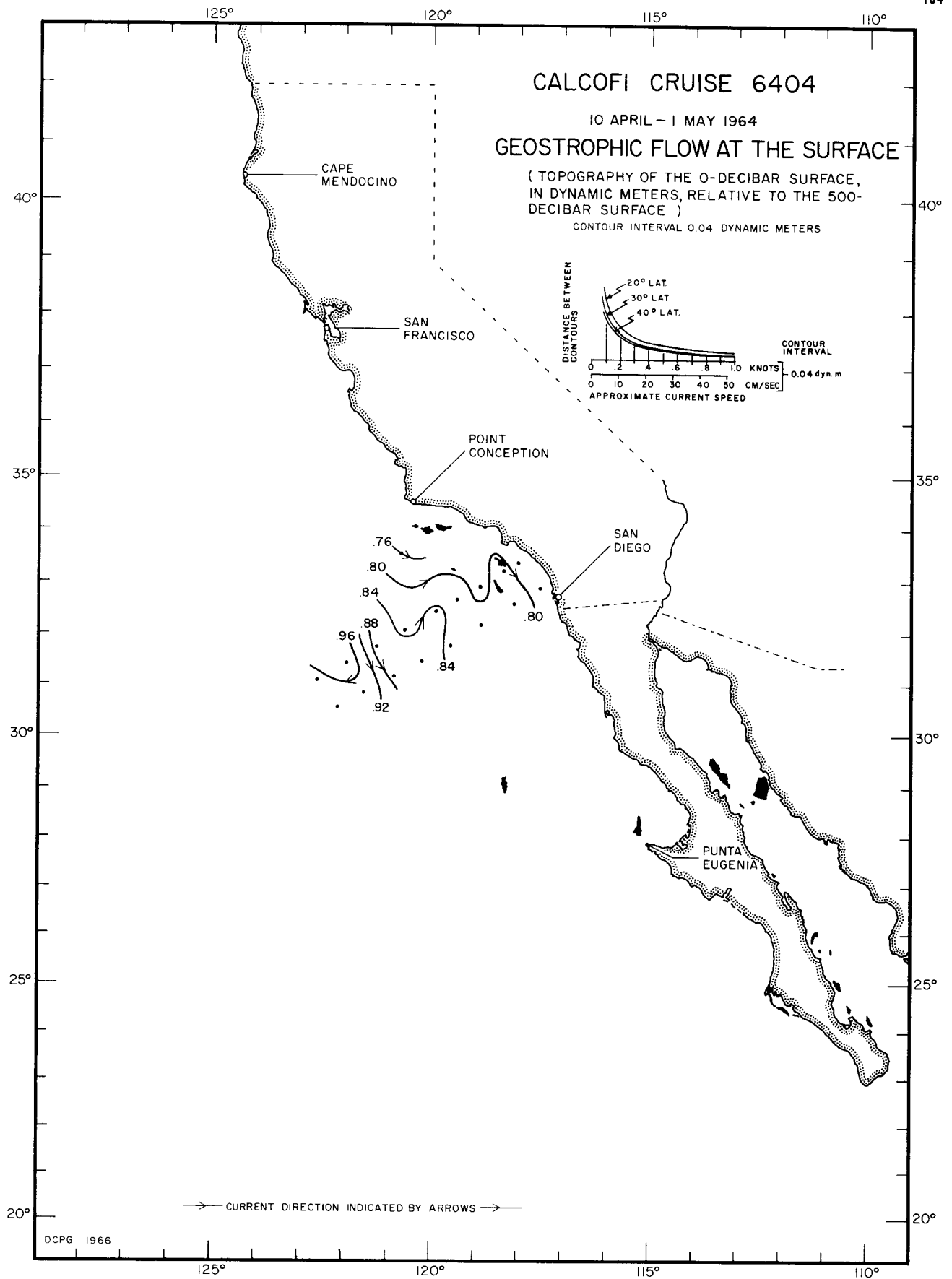


O/500 db  
6310

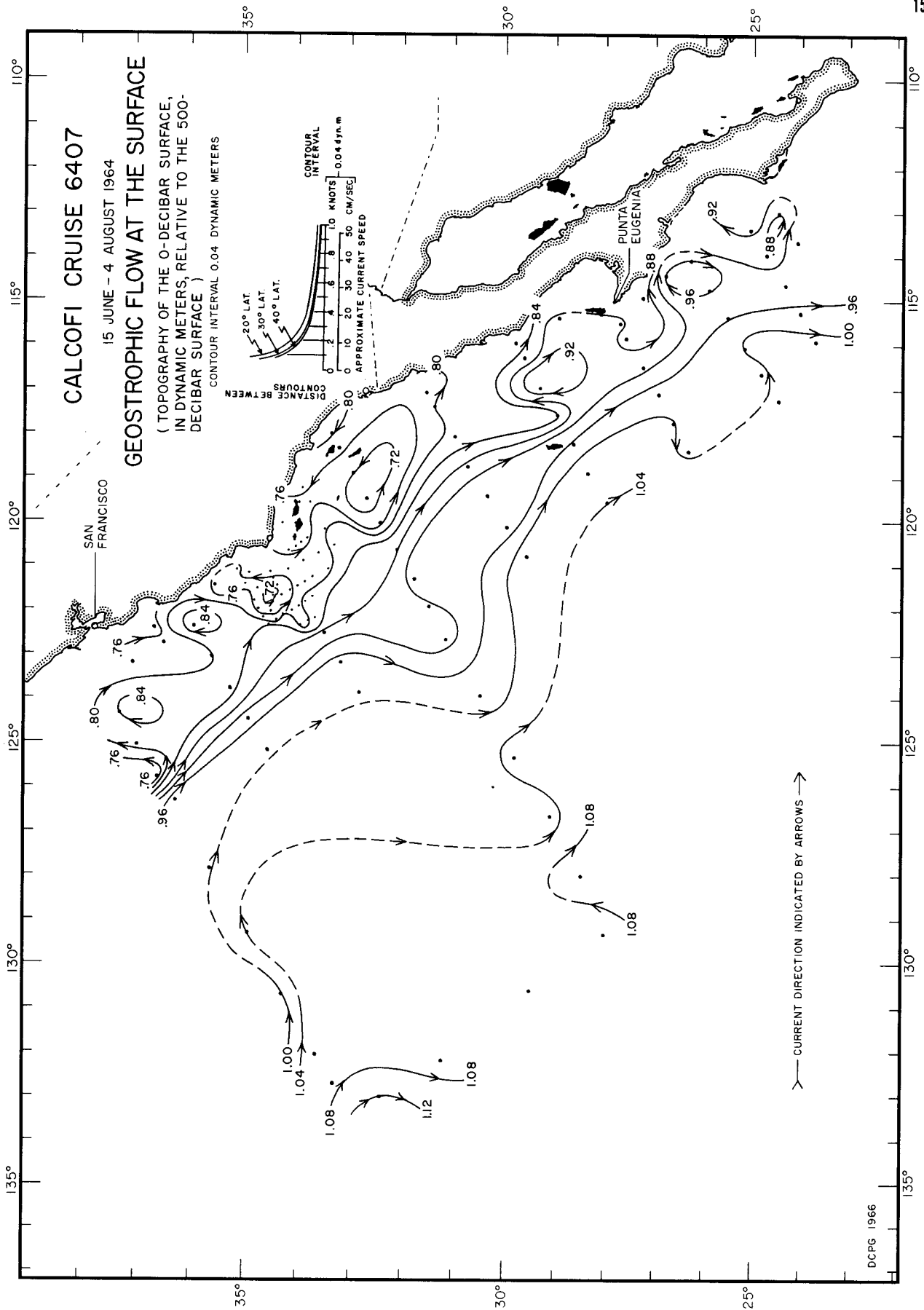


DCPG 1966

O/500 db  
6401

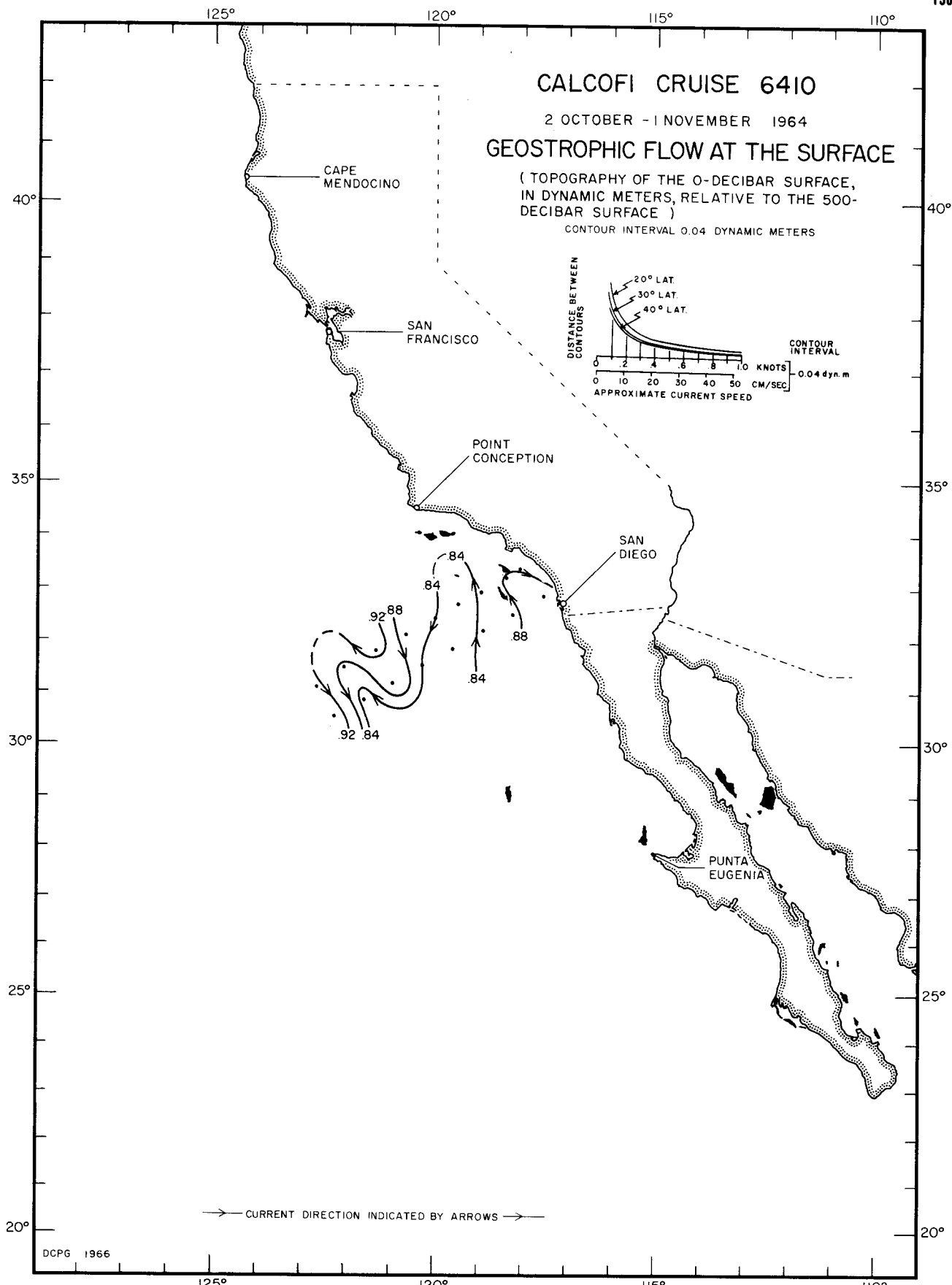


0/500 db  
6404



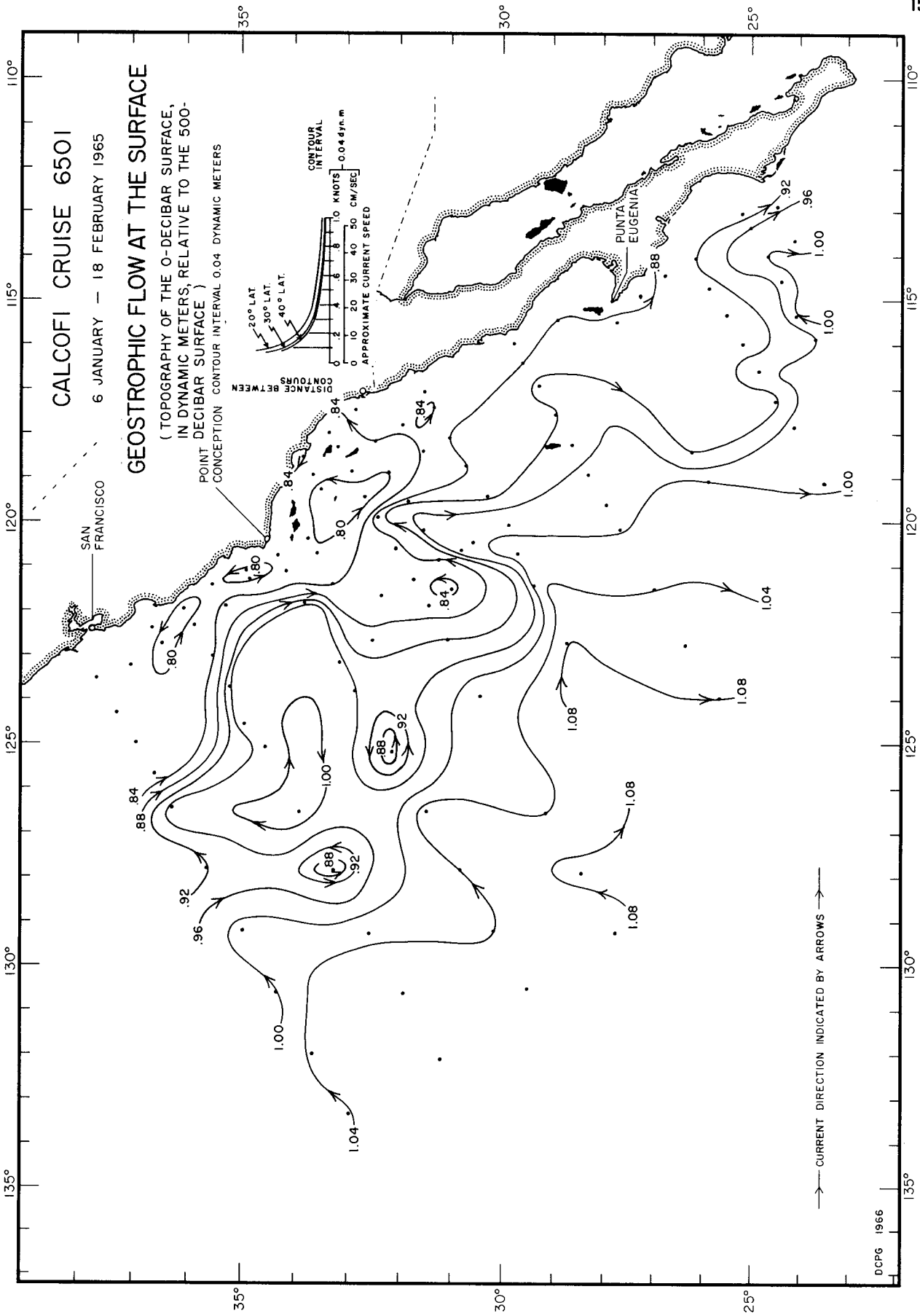
DCPG 1966

0/500 db  
6407



DCPG 1966

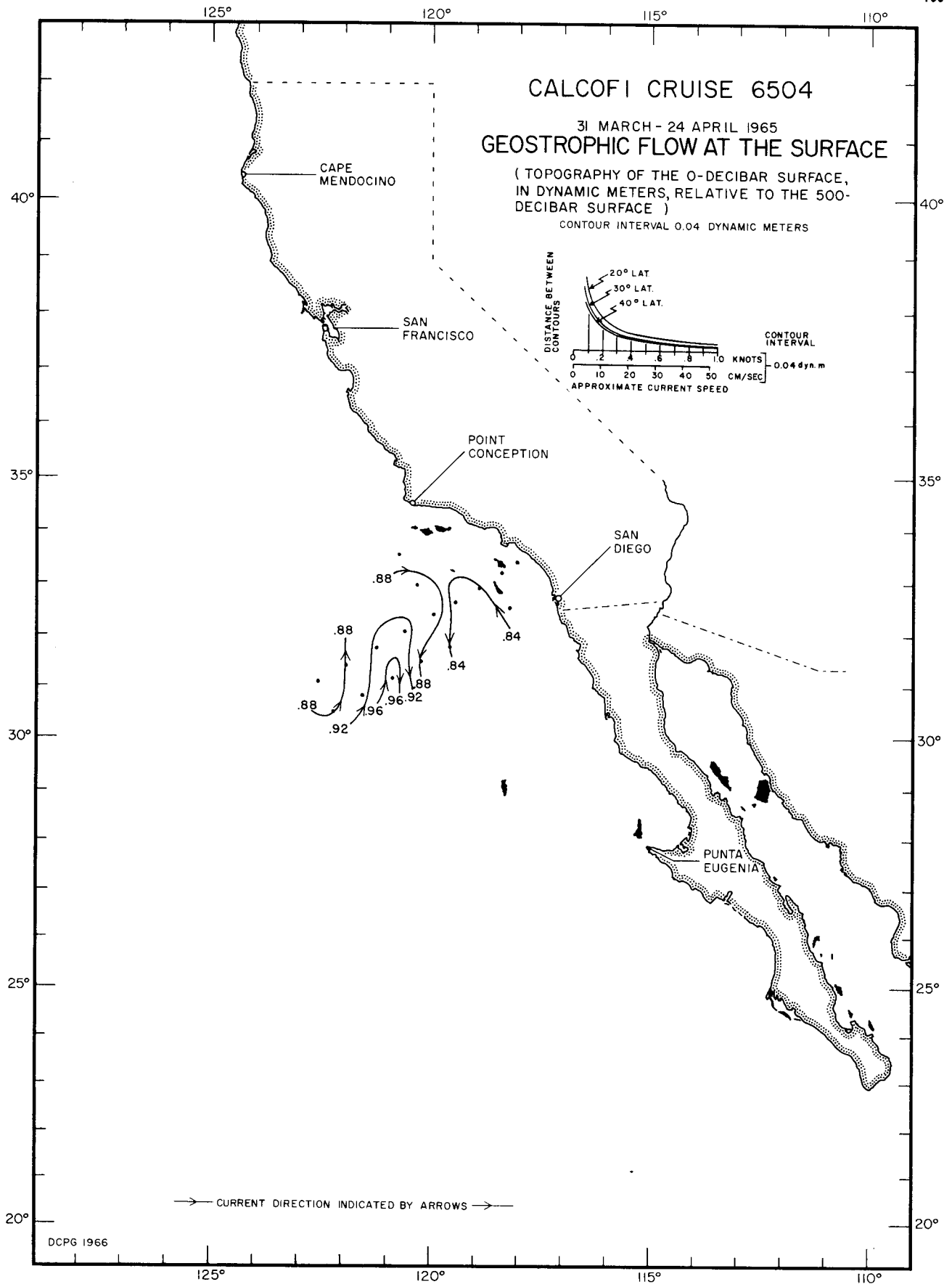
O/500 db  
6410



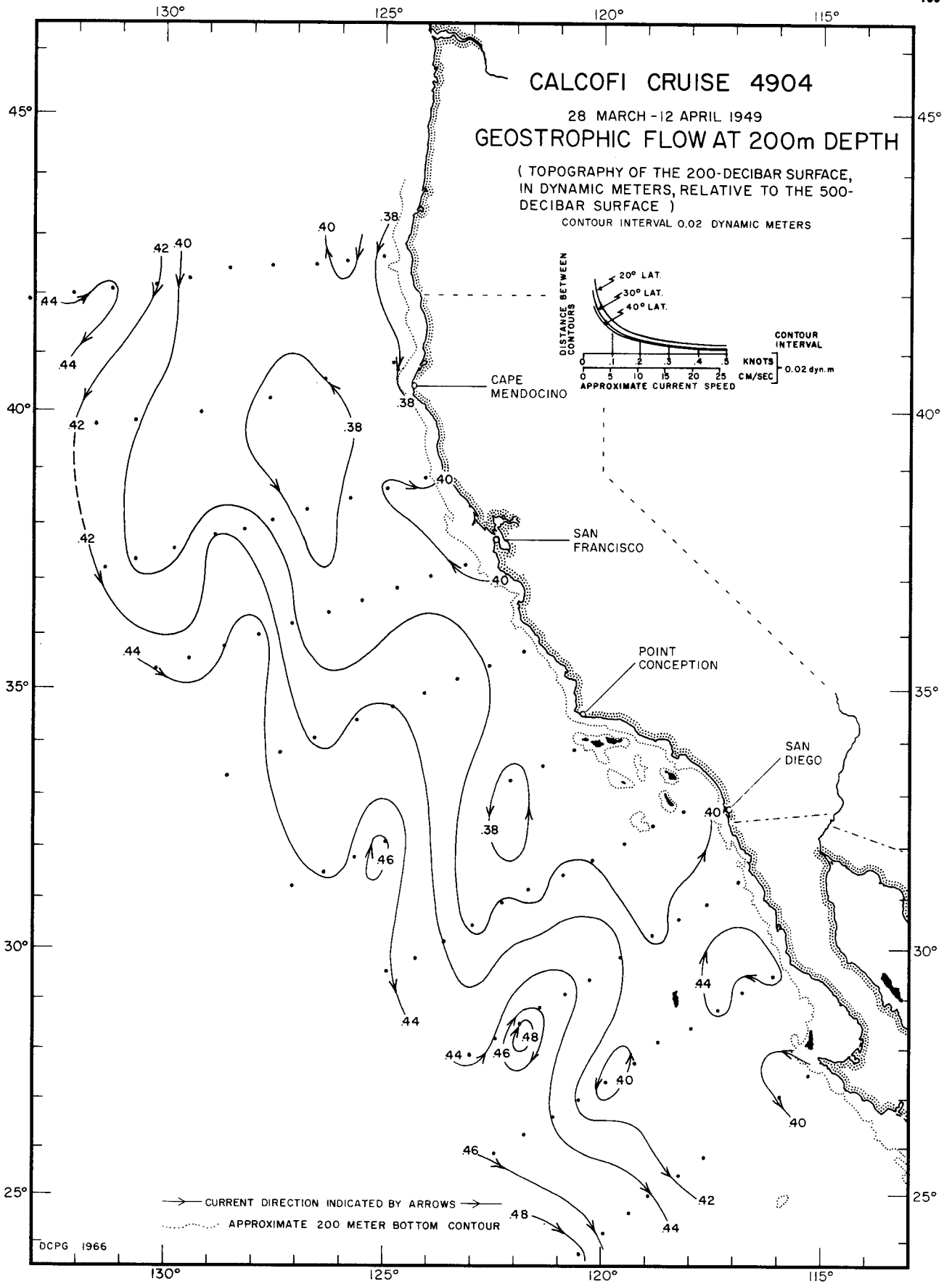
0/500 db  
6501

DCPF 1966

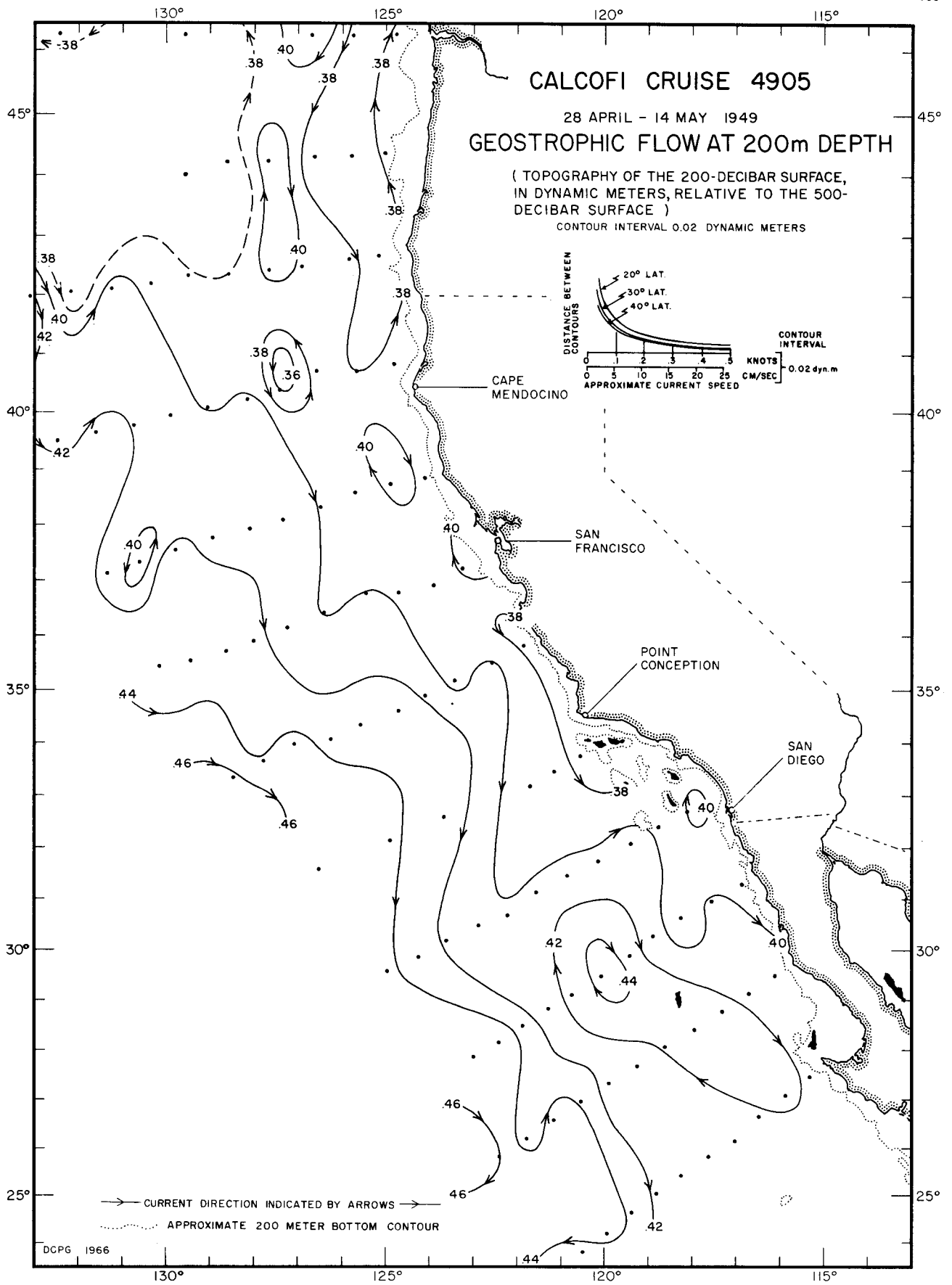


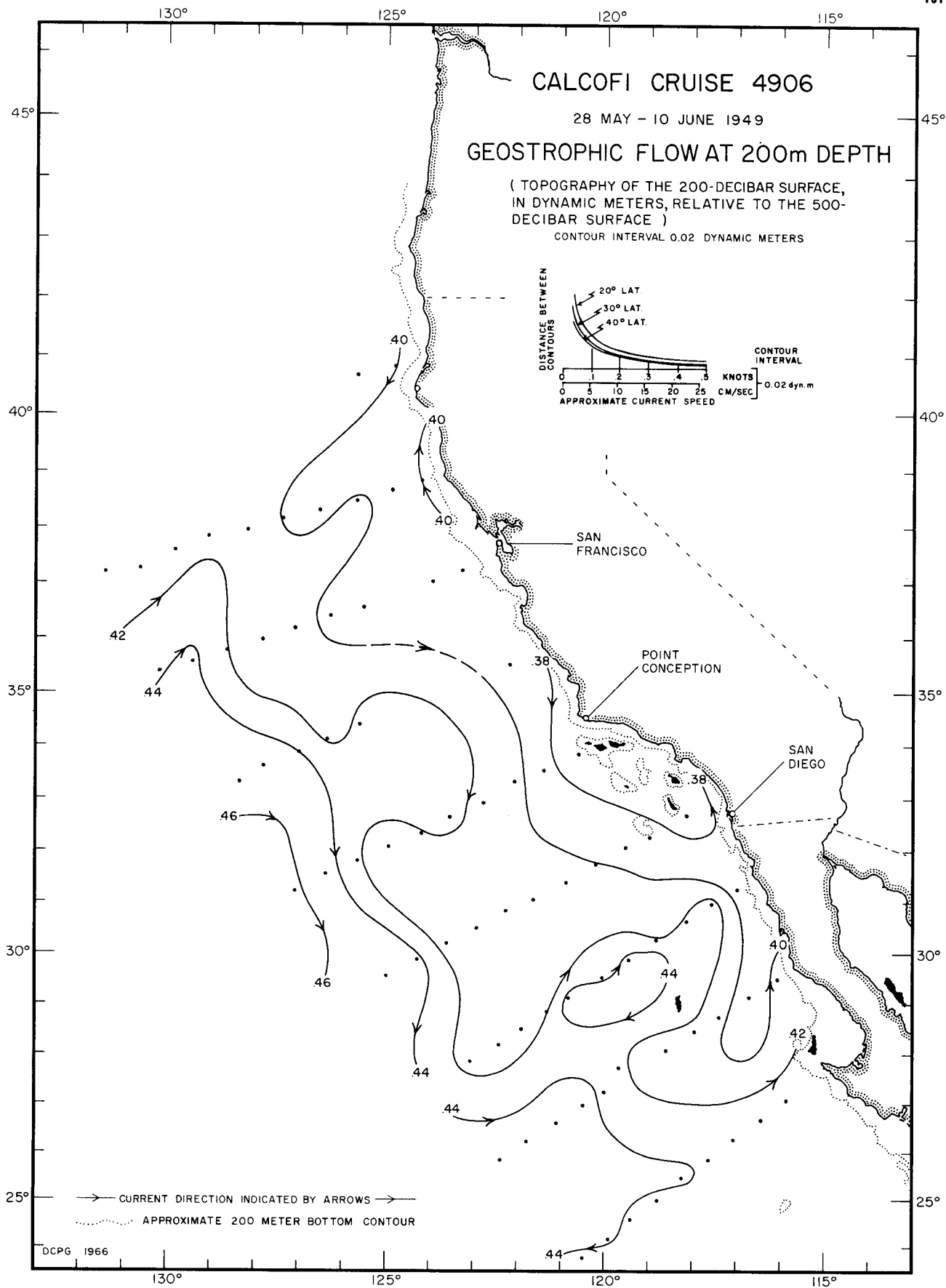


O/500 db  
6504

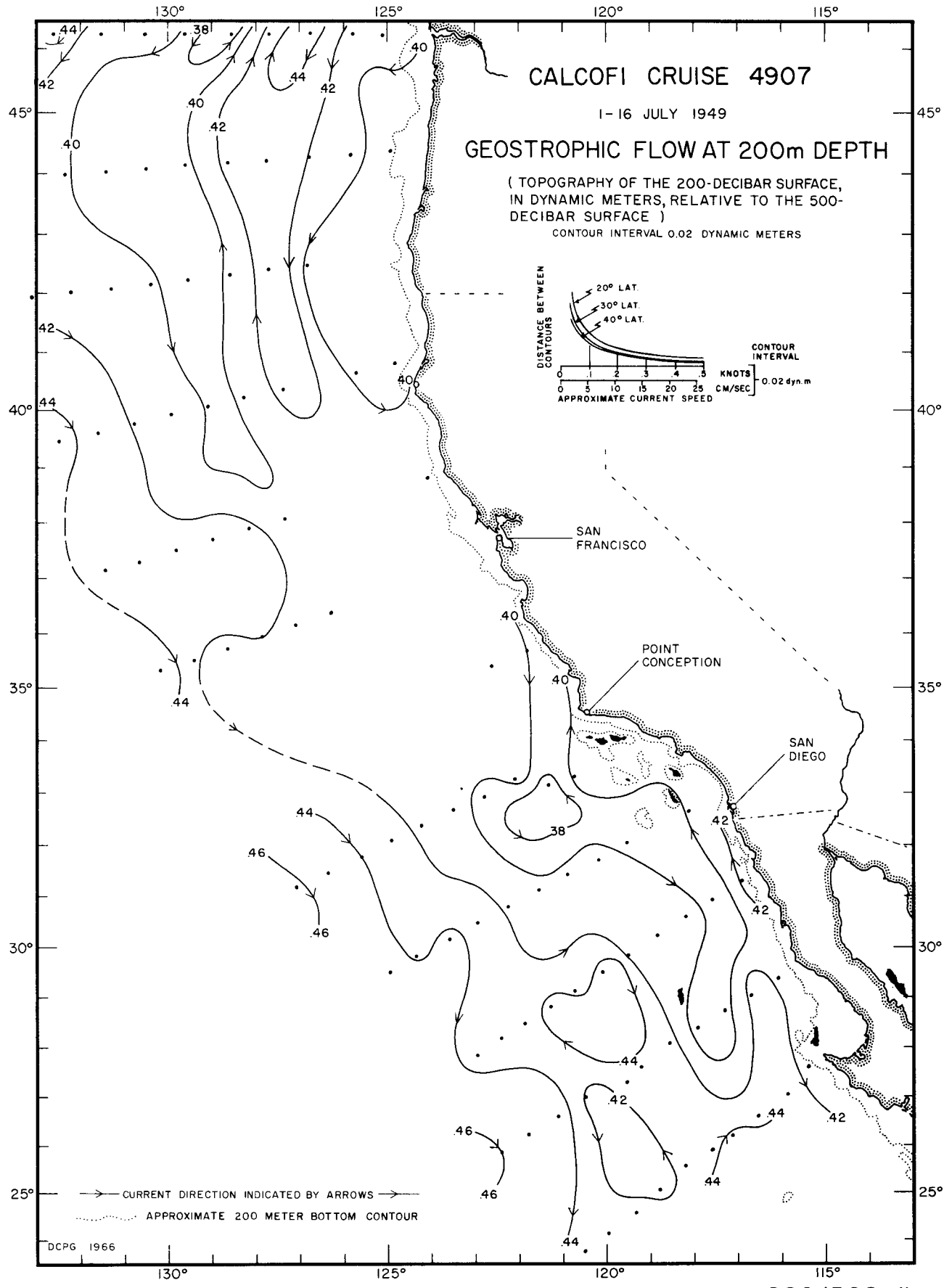


200/500 db  
4904

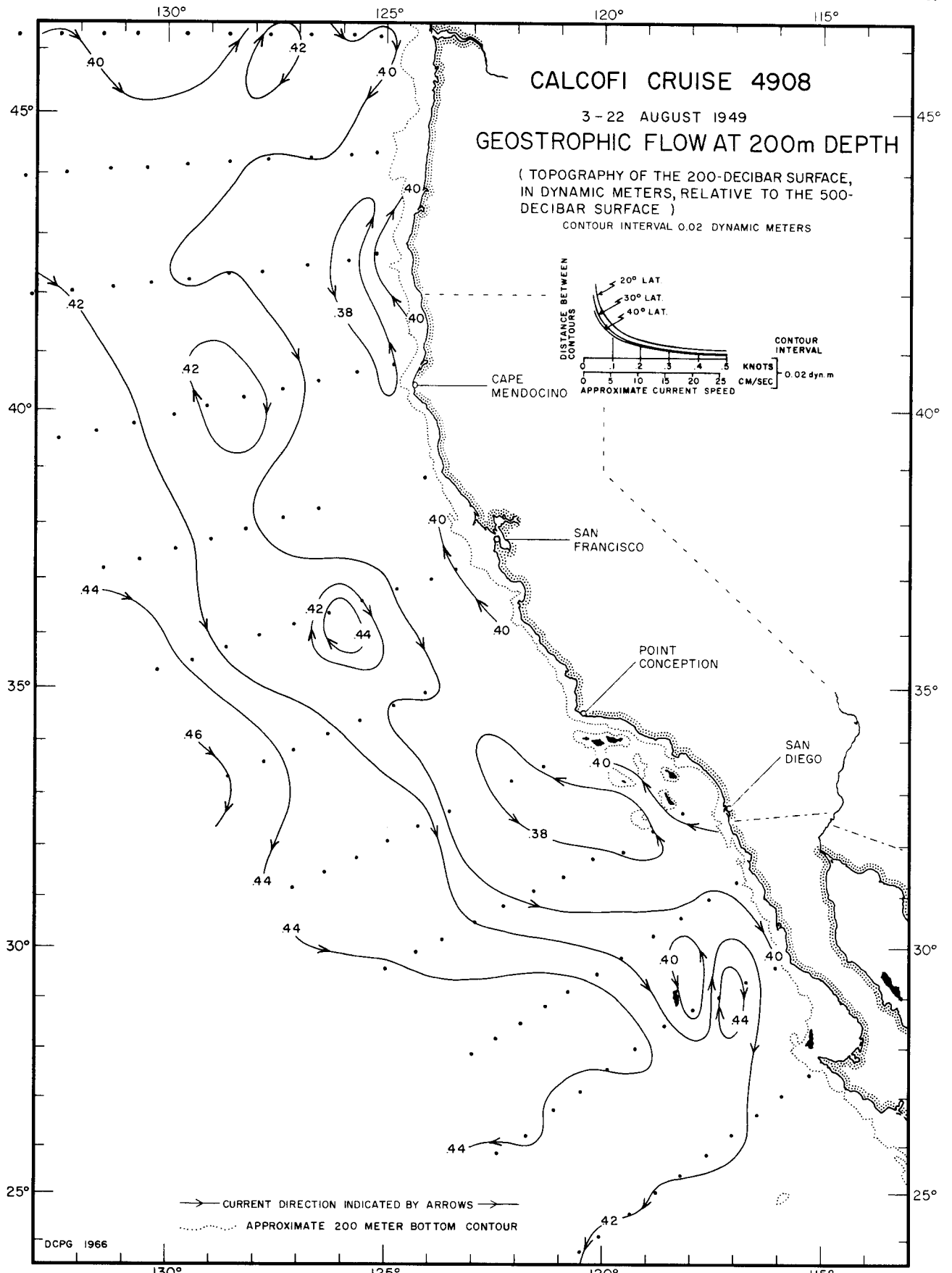




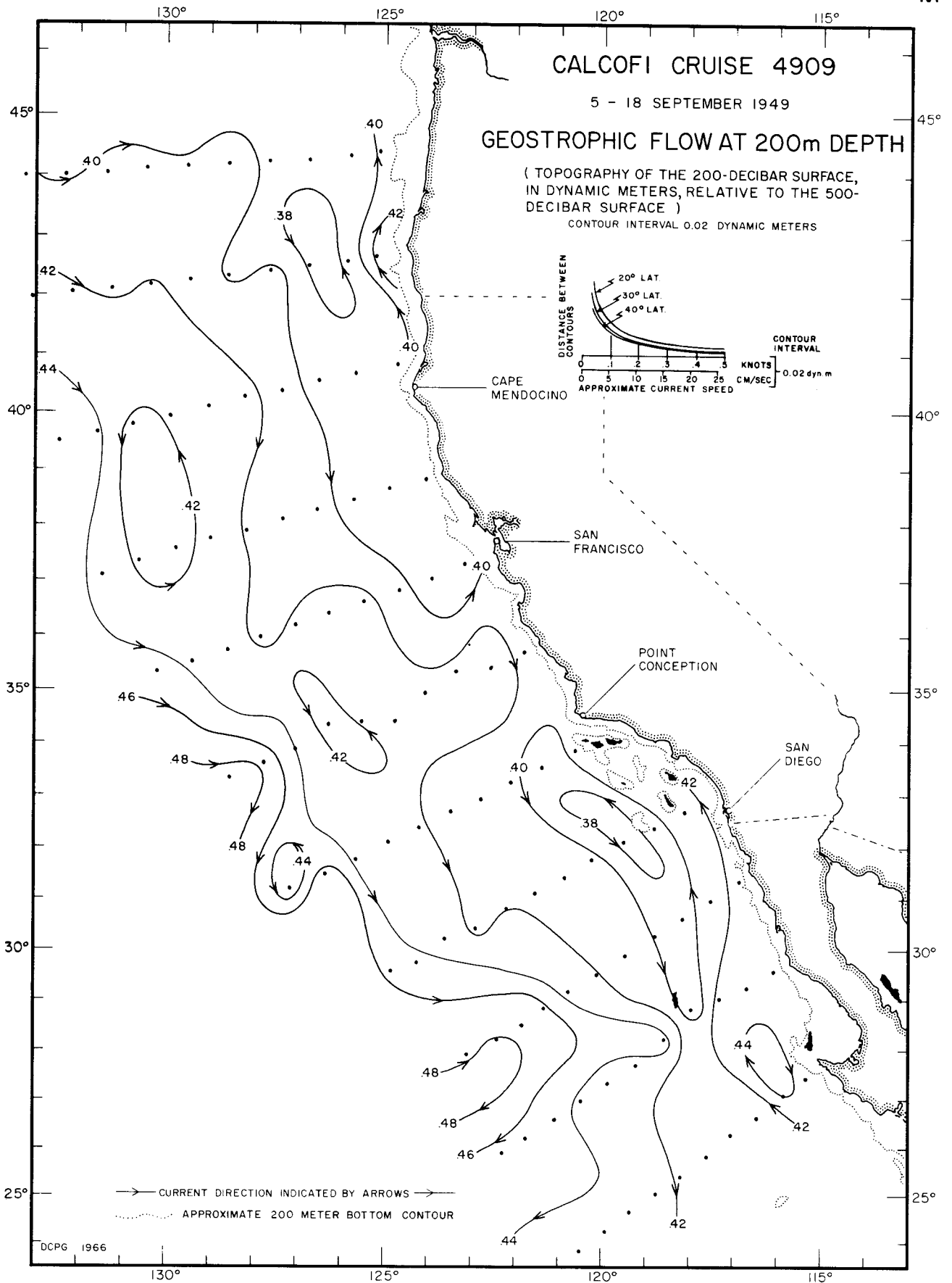
200/500 db  
4906



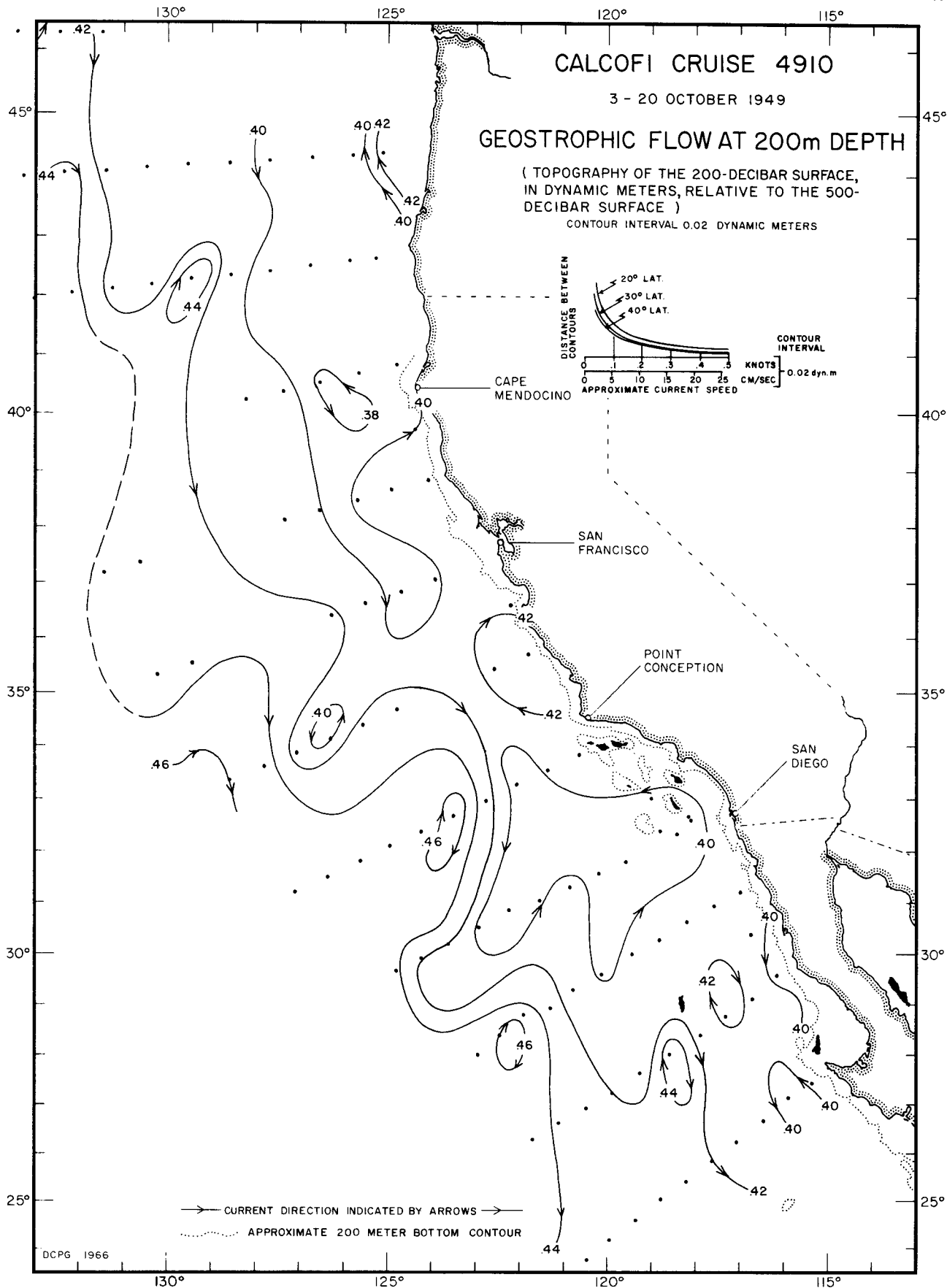
200/500 db  
4907



200/500 db  
4908

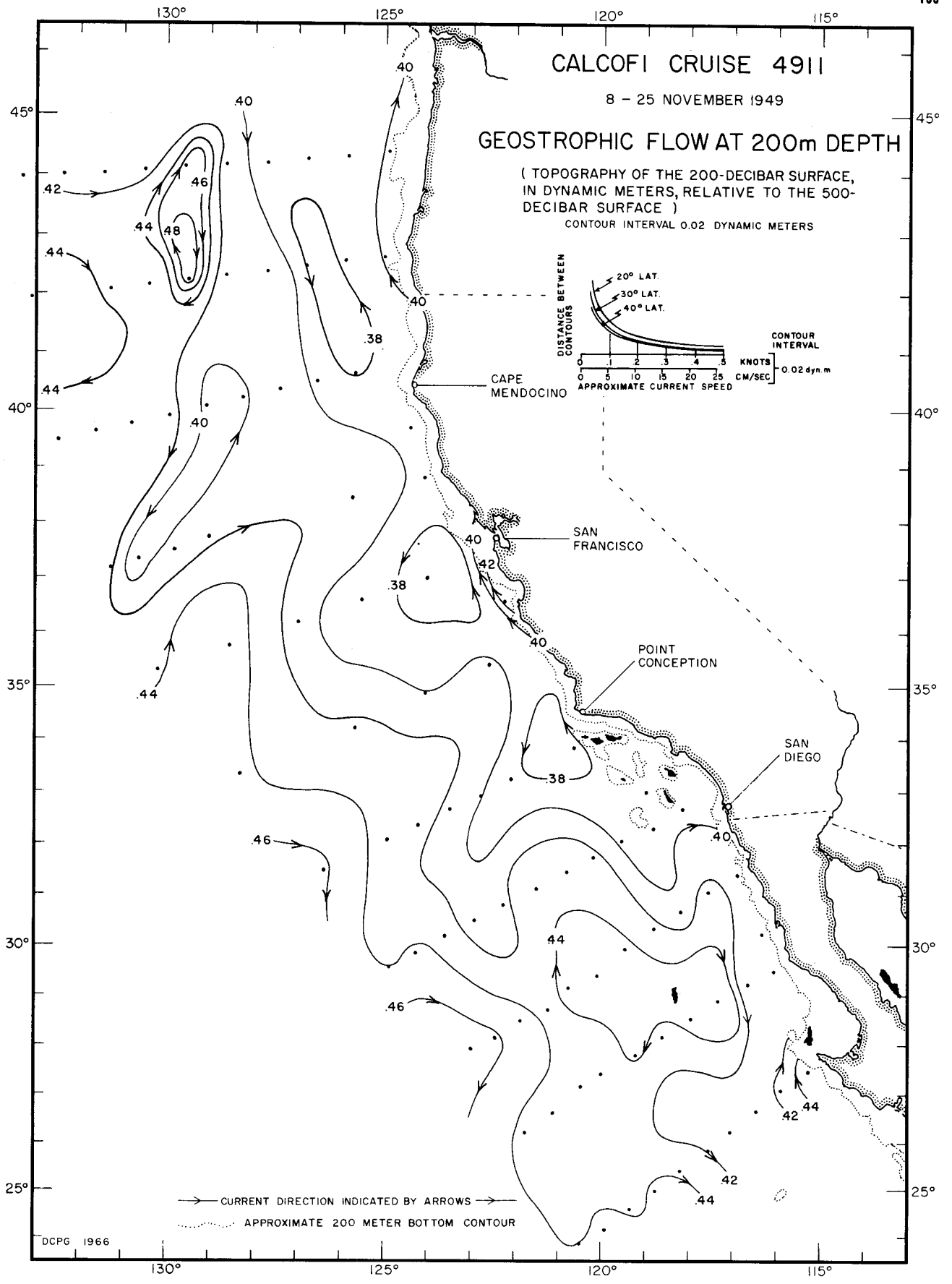


200/500 db  
4909

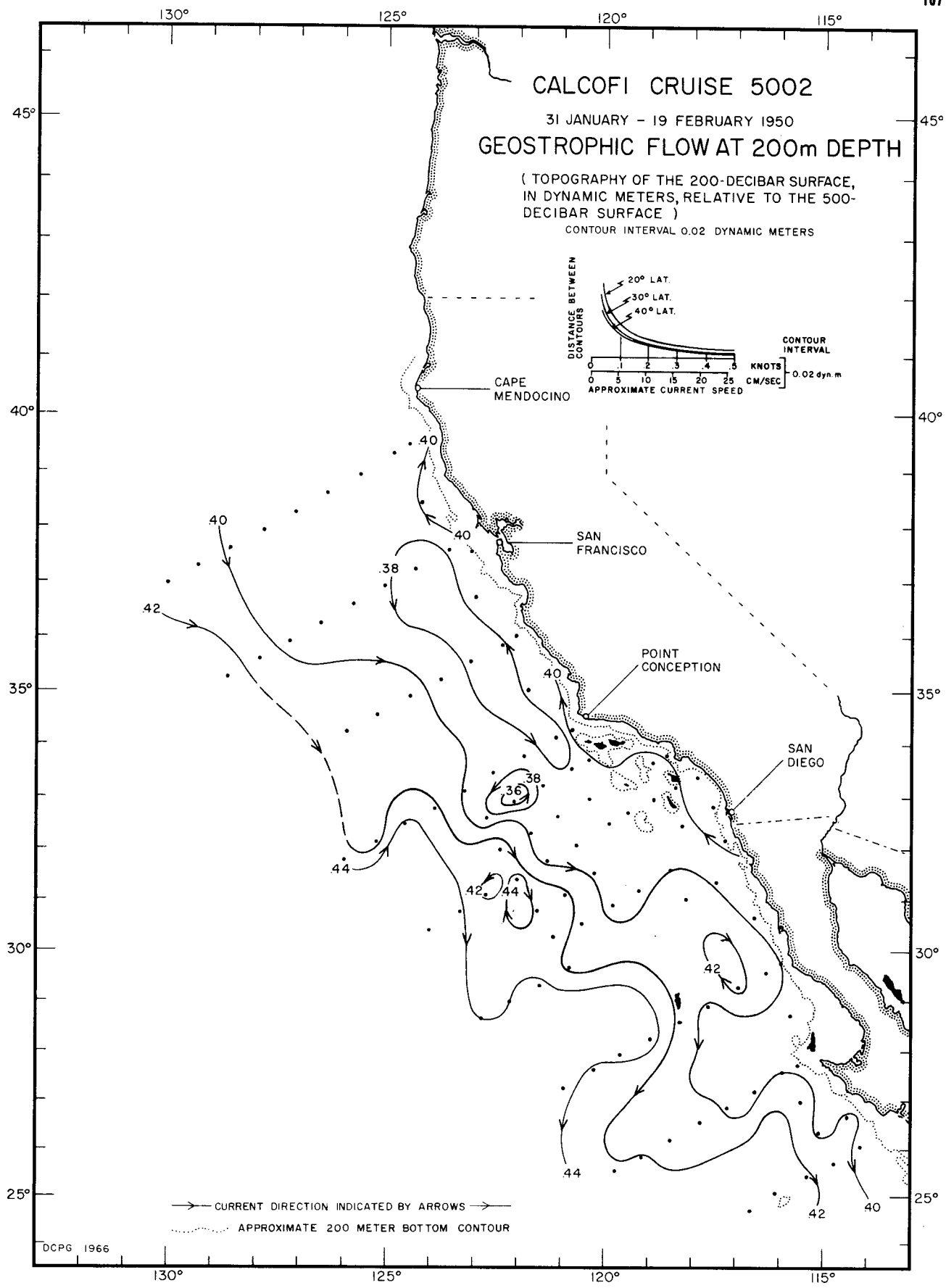


200/500 db  
4910

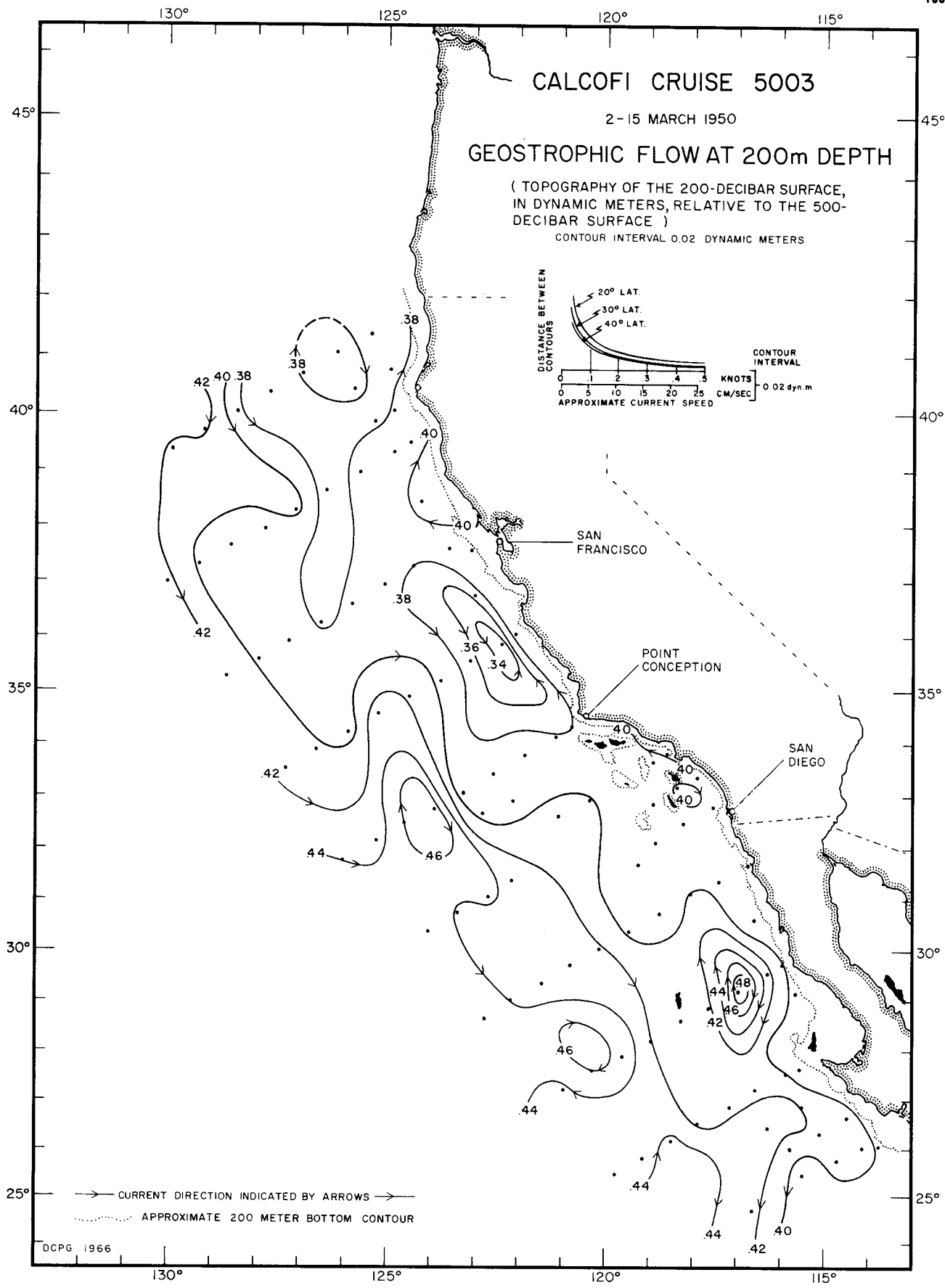




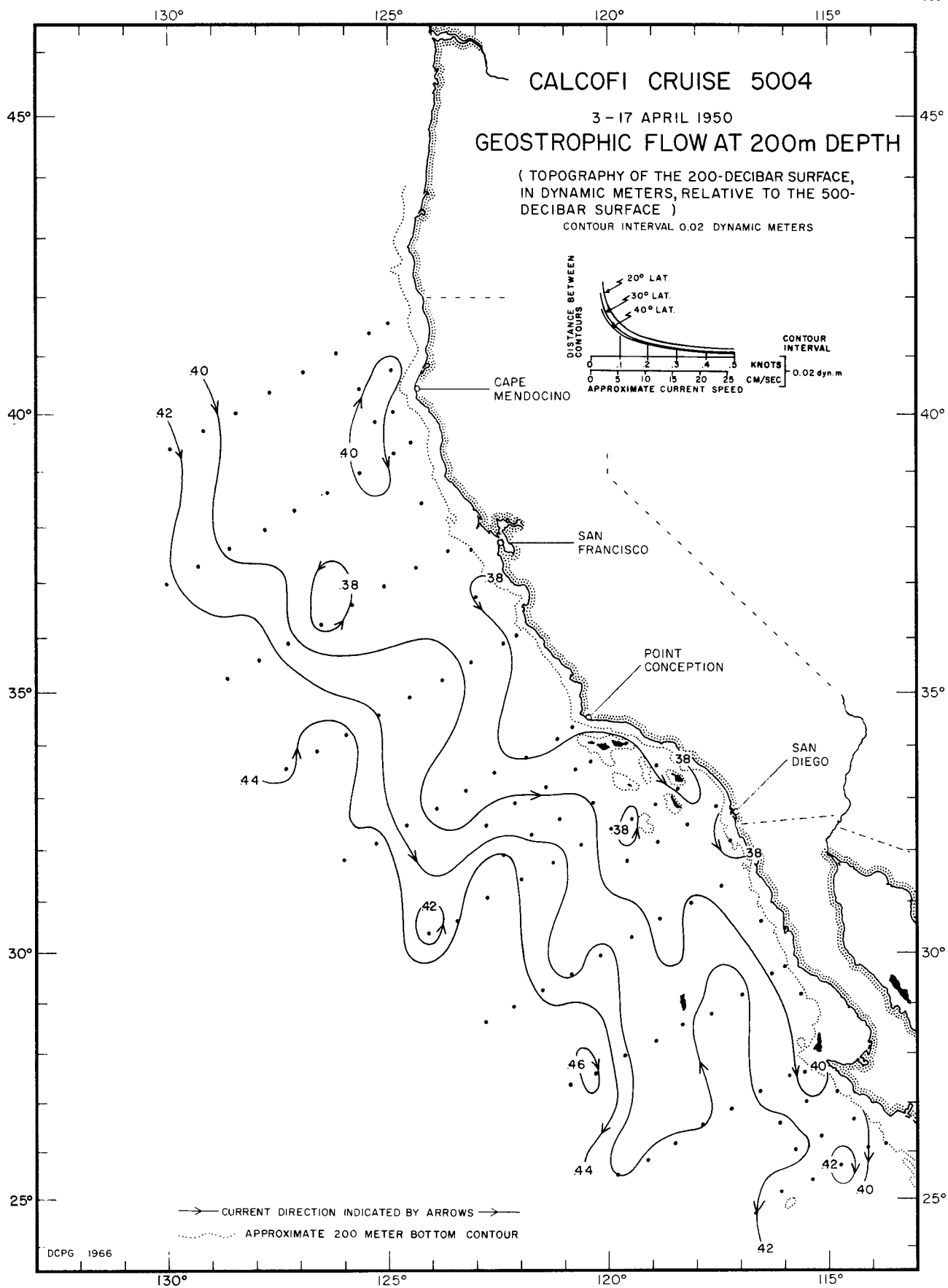
200/500 db  
4911



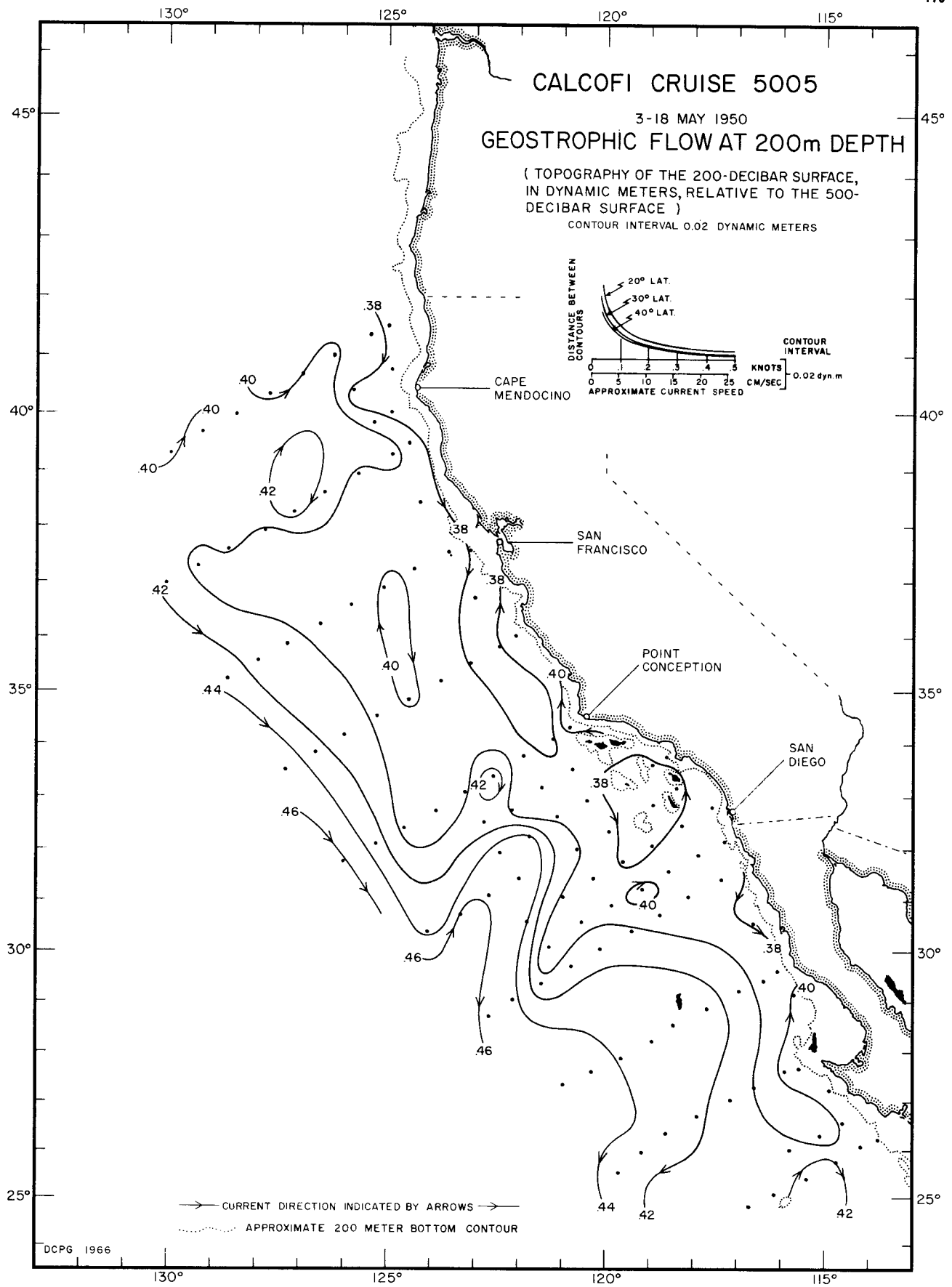
200/500 db  
5002



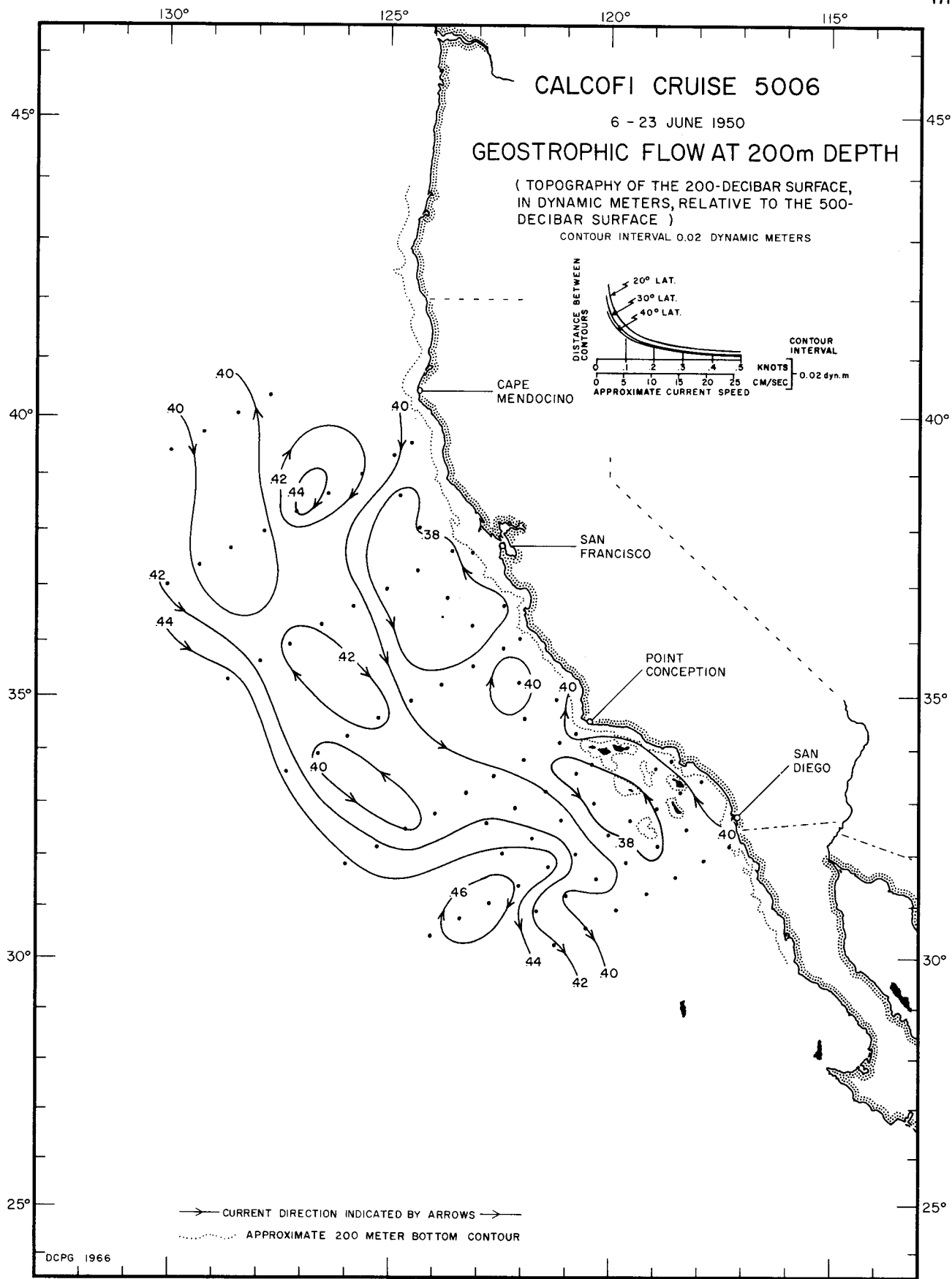
200/500 db  
5003



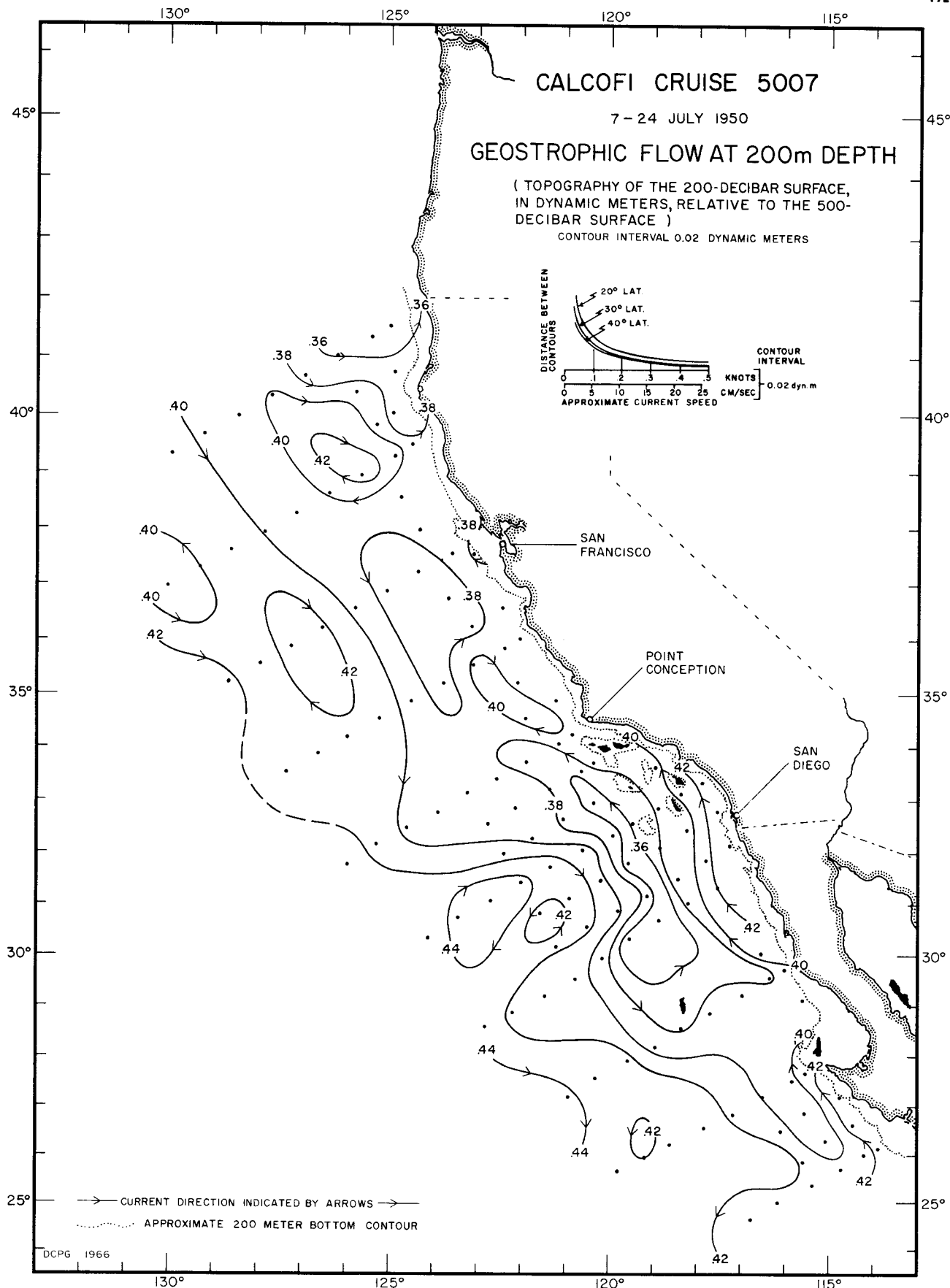
200/500 db  
 5004



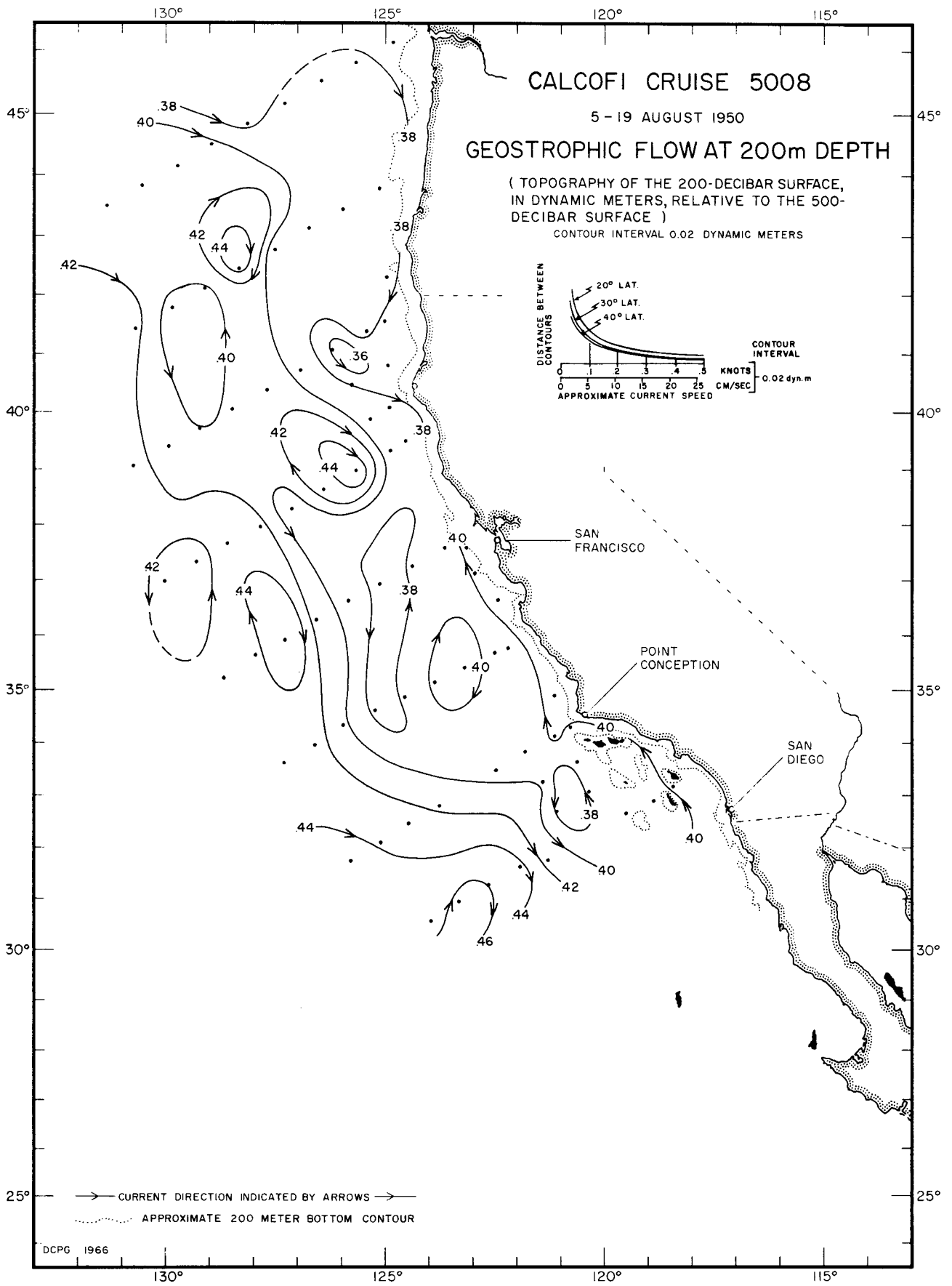
200/500 db  
5005



200/500 db  
5006



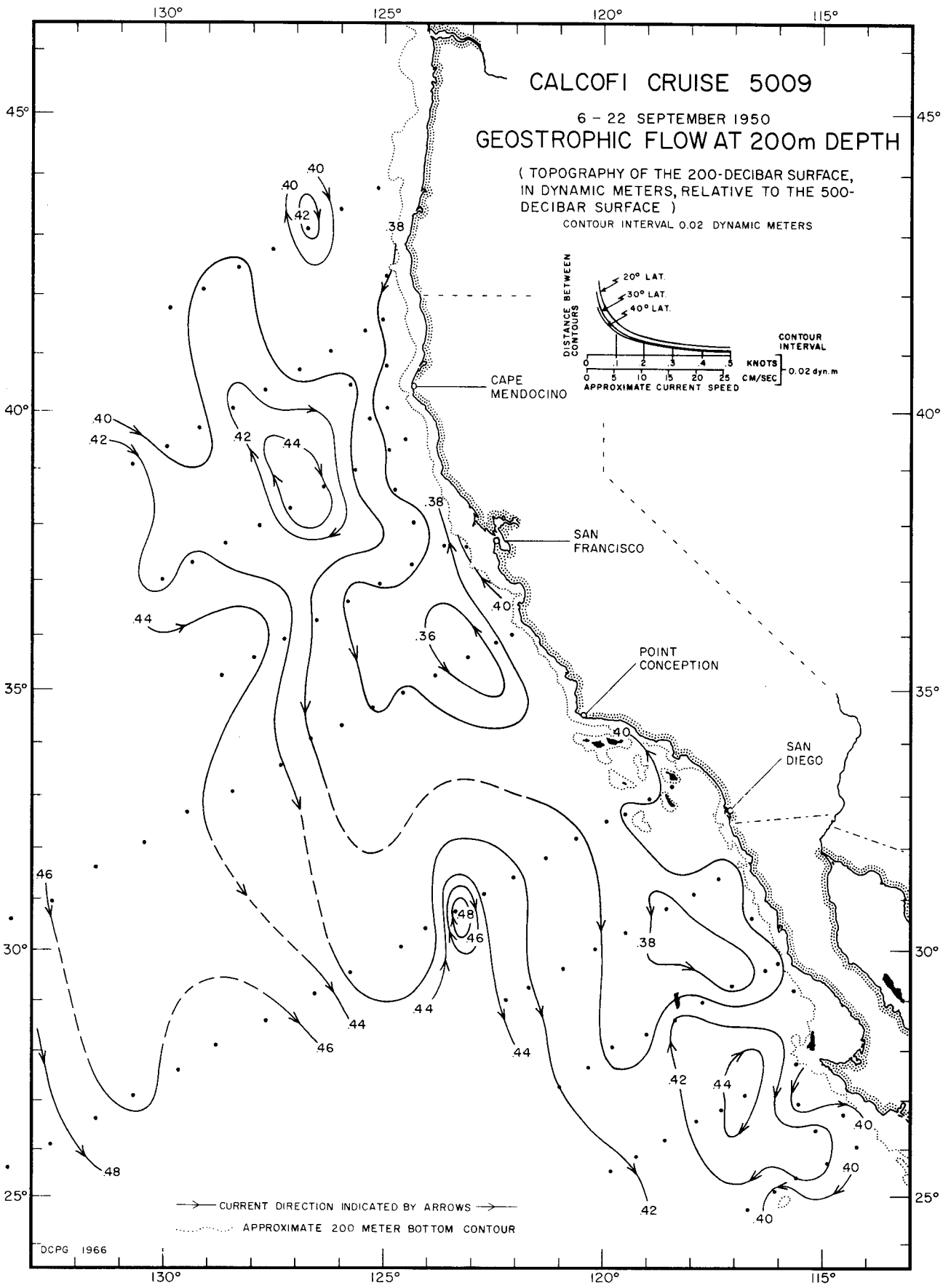
200/500 db  
5007



DCPG 1966

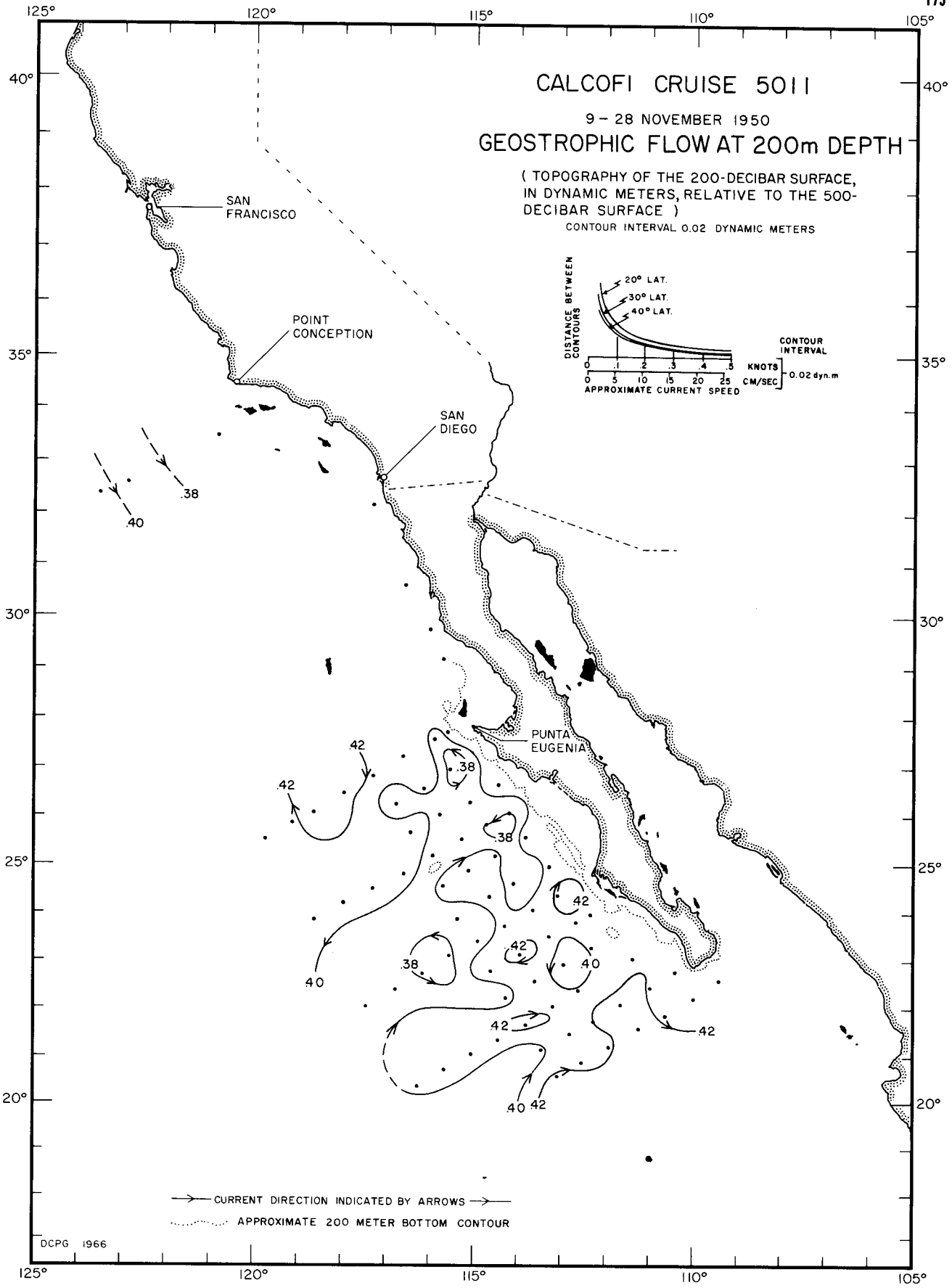
200/500 db  
5008





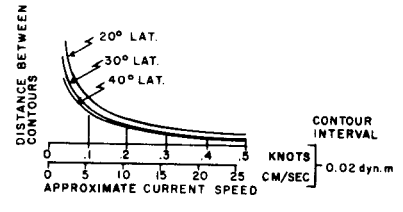
DCPG 1966

200/500 db  
5009



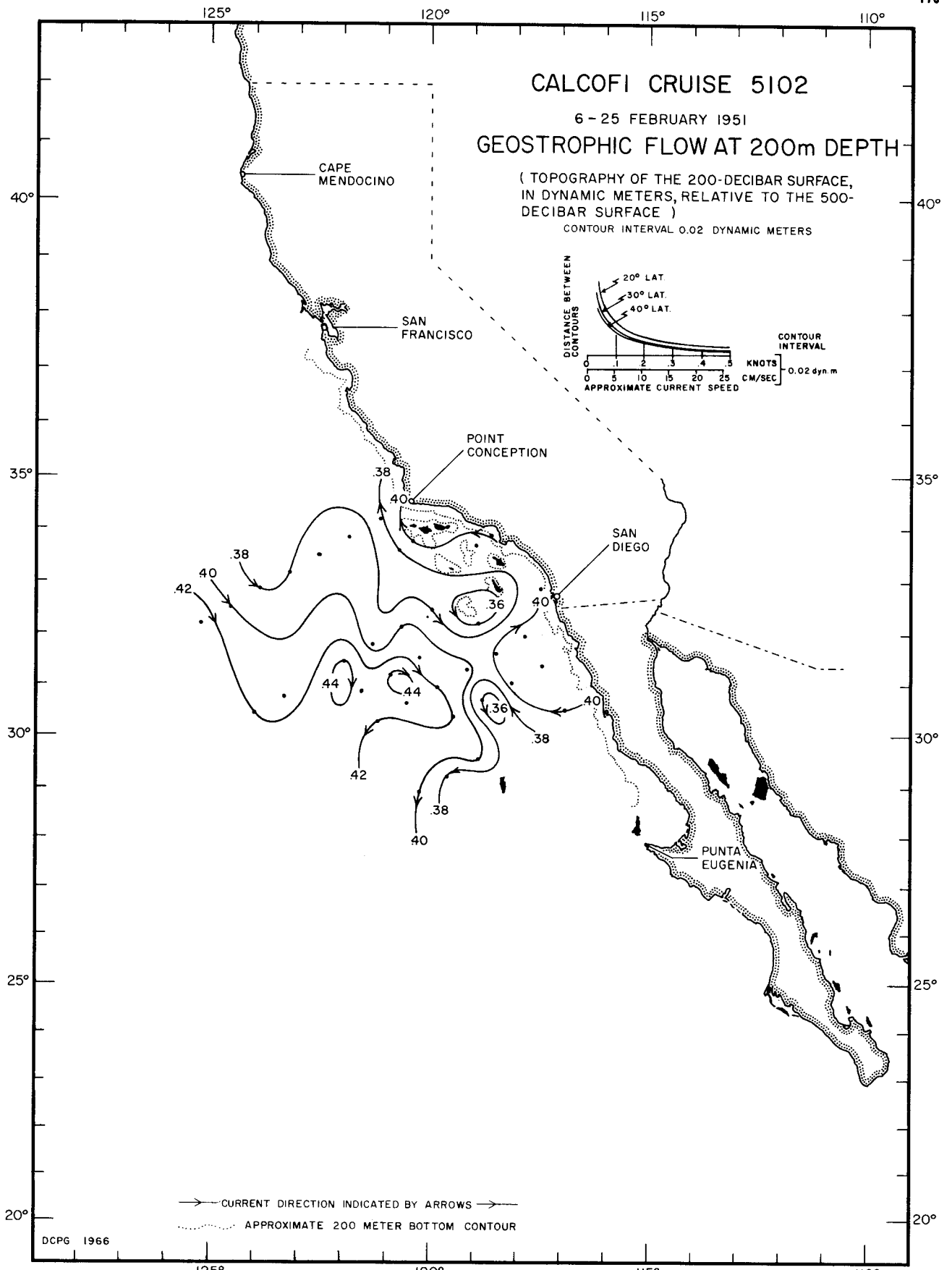
CALCOFI CRUISE 5011  
 9 - 28 NOVEMBER 1950  
 GEOSTROPHIC FLOW AT 200m DEPTH

( TOPOGRAPHY OF THE 200-DECIBAR SURFACE,  
 IN DYNAMIC METERS, RELATIVE TO THE 500-  
 DECIBAR SURFACE )  
 CONTOUR INTERVAL 0.02 DYNAMIC METERS

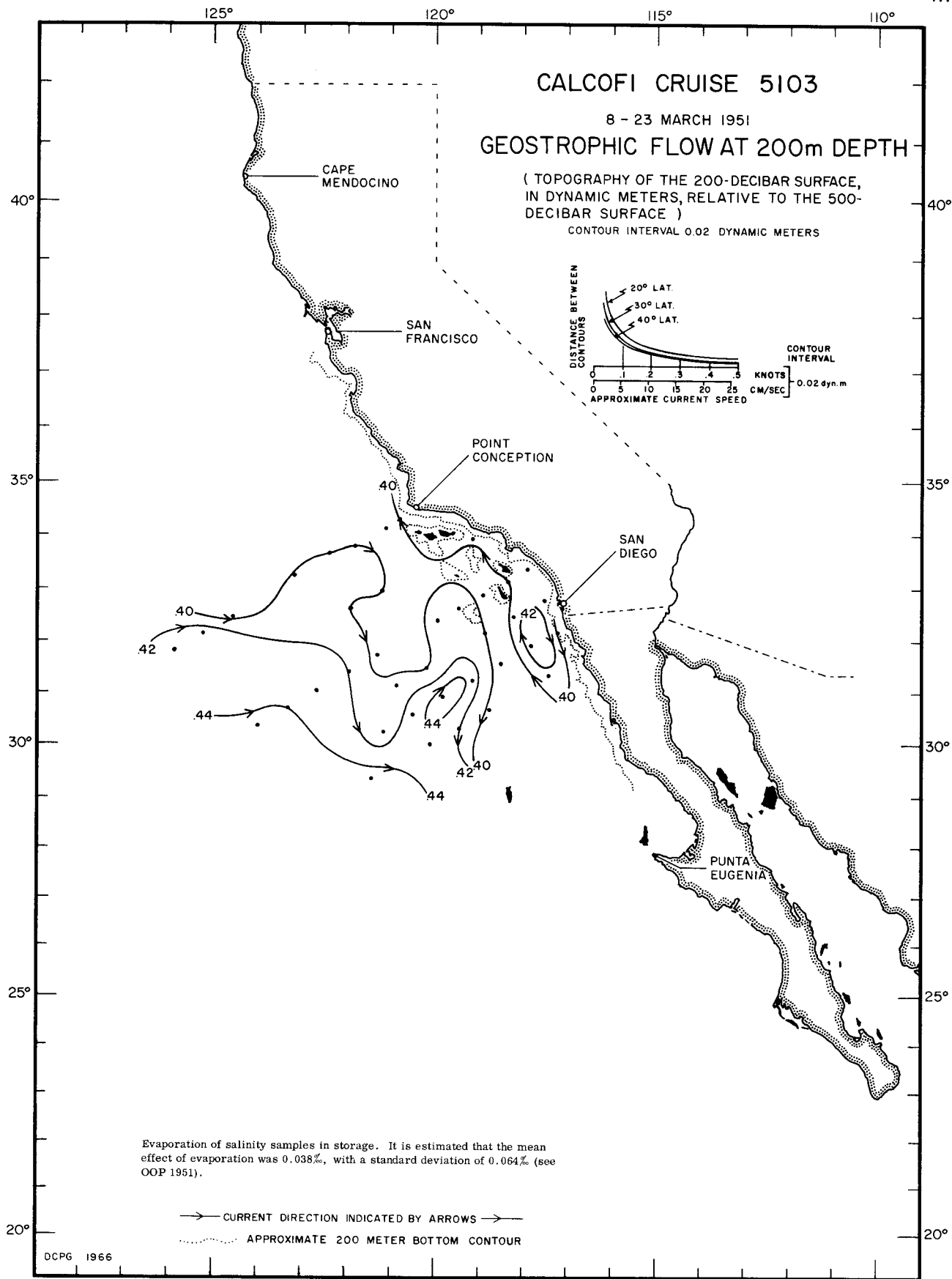


→ CURRENT DIRECTION INDICATED BY ARROWS →  
 - - - - - APPROXIMATE 200 METER BOTTOM CONTOUR

200/500 db  
 5011

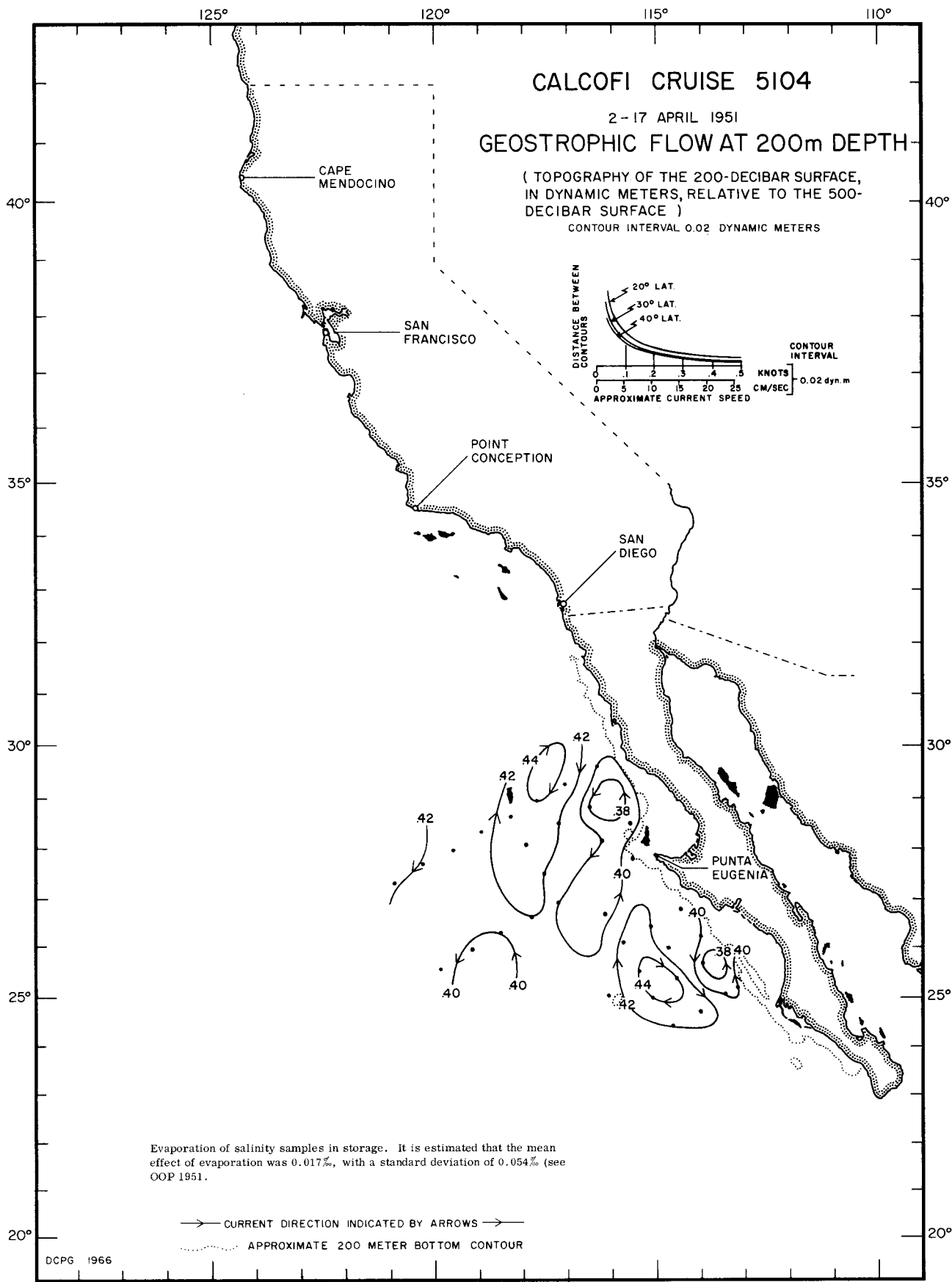


200/500 db  
5102

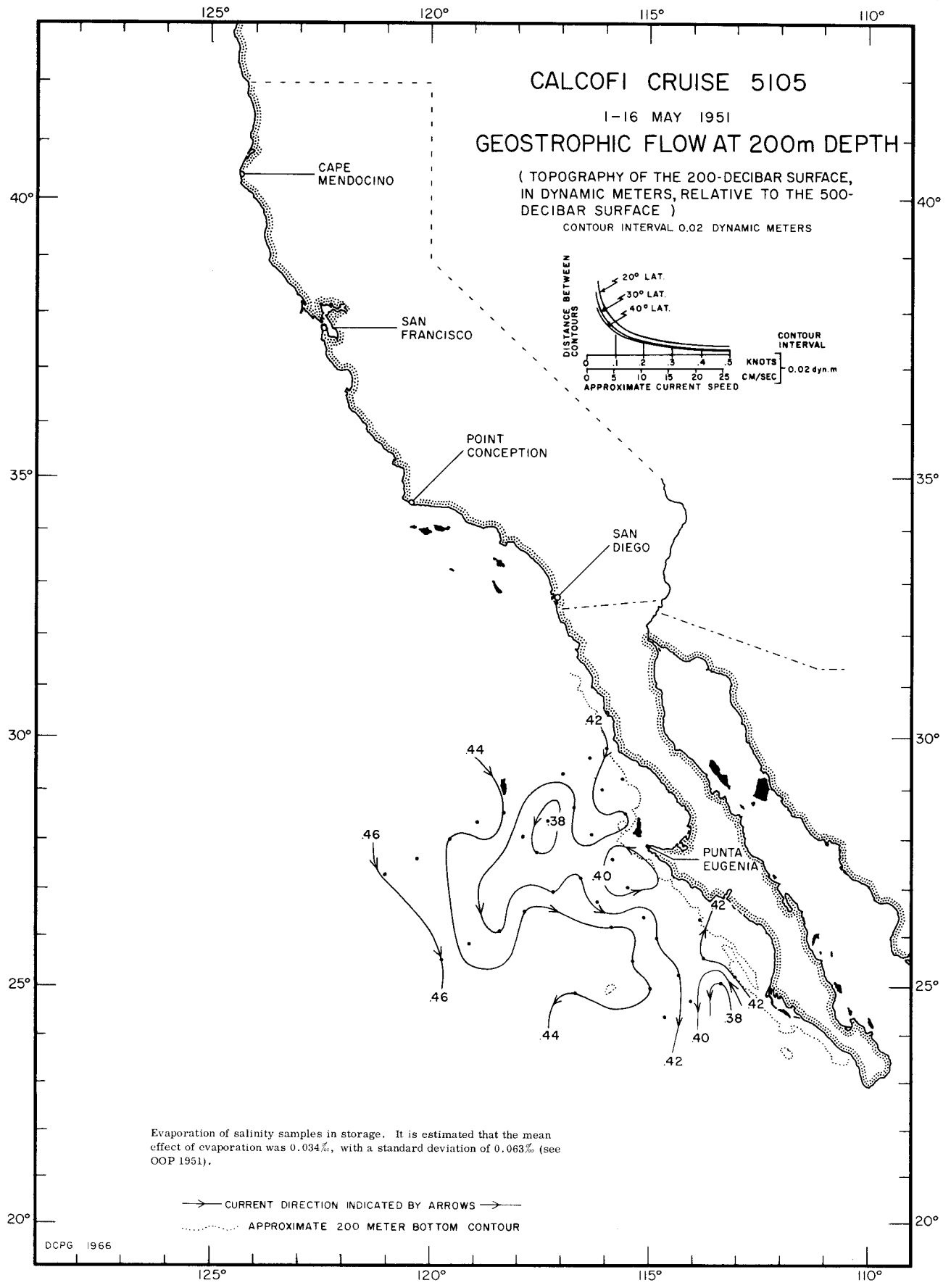


DCPG 1966

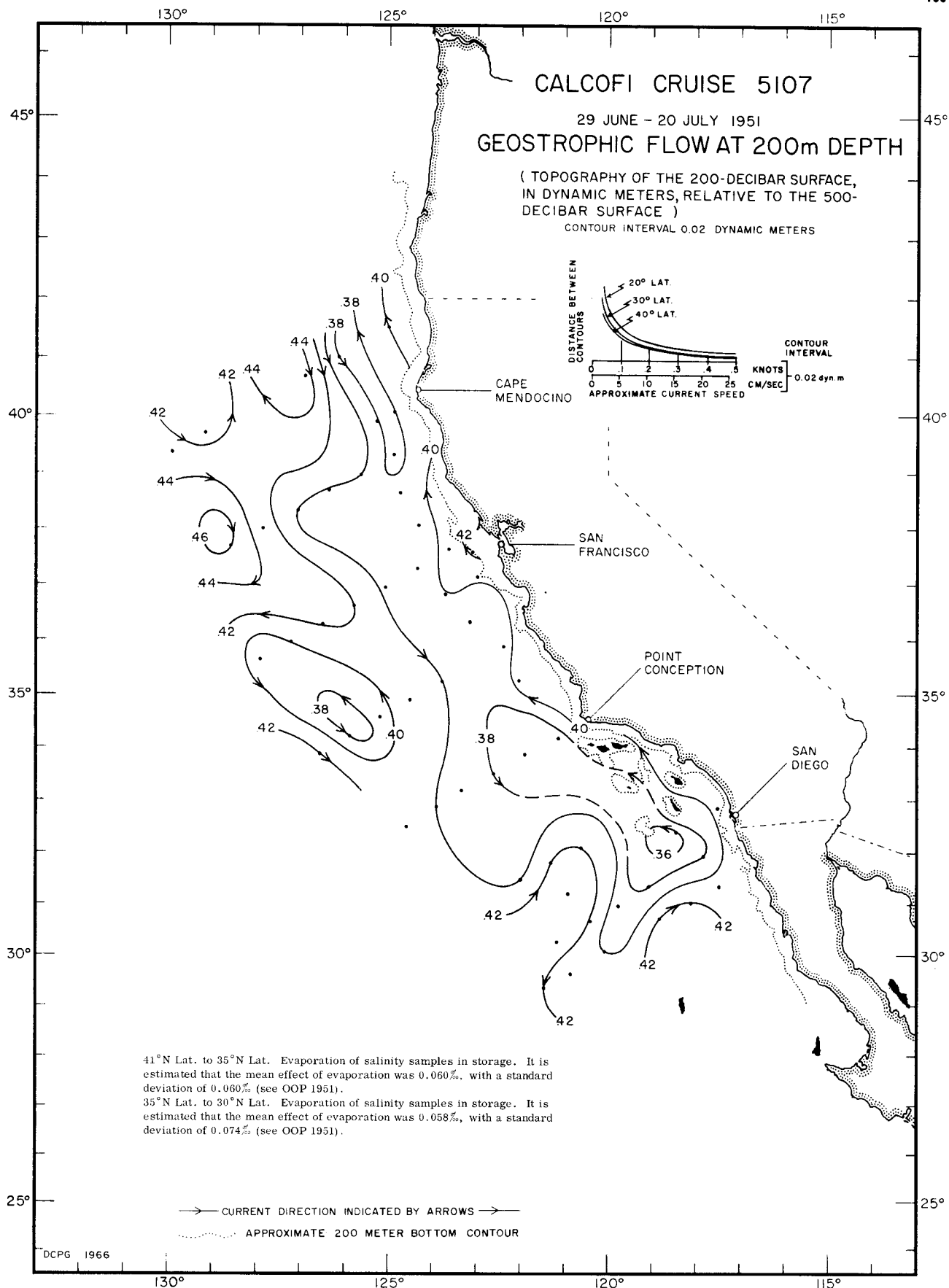
200/500 db  
5103



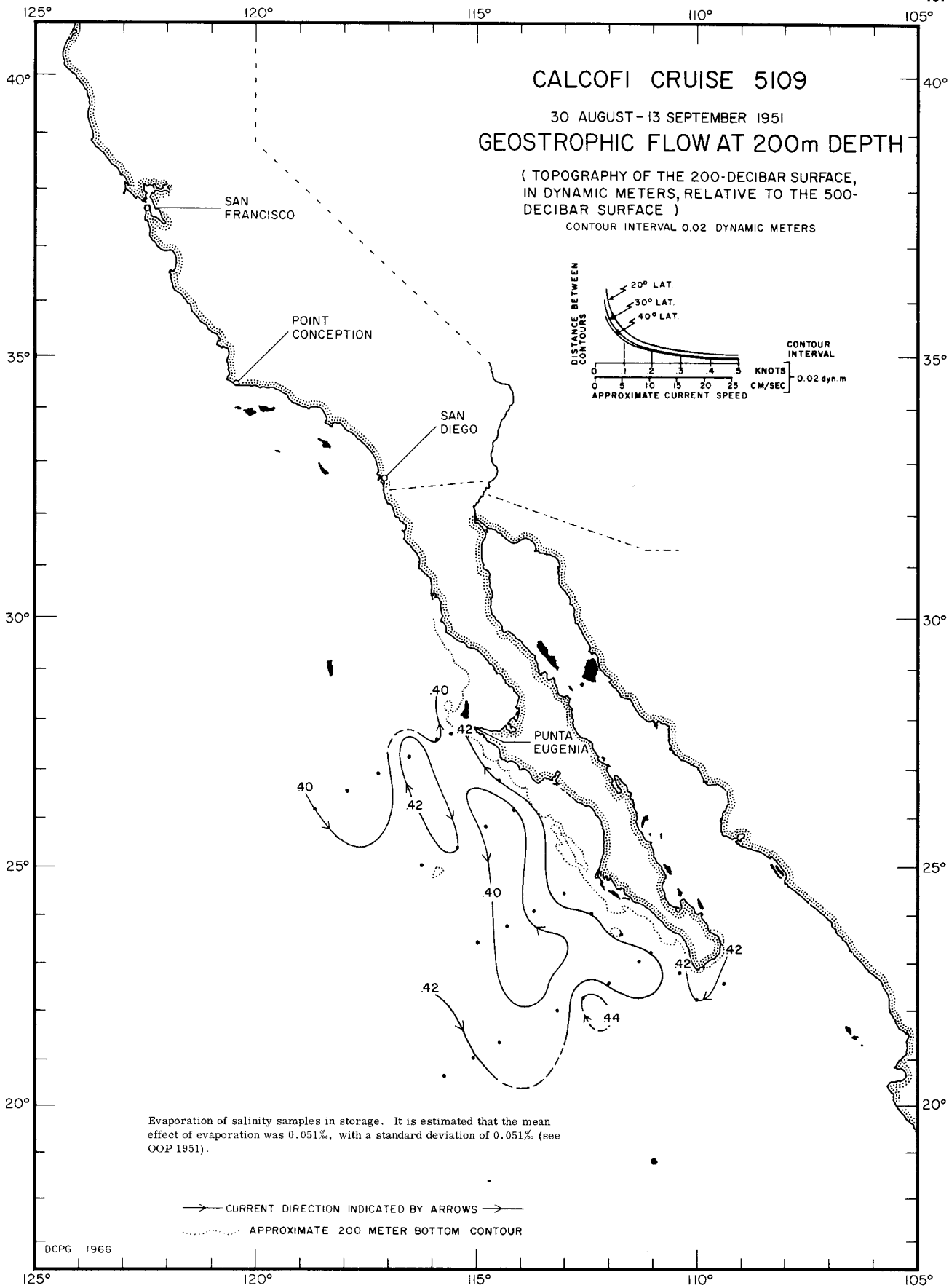
200/500 db  
5104



200/500 db  
5105

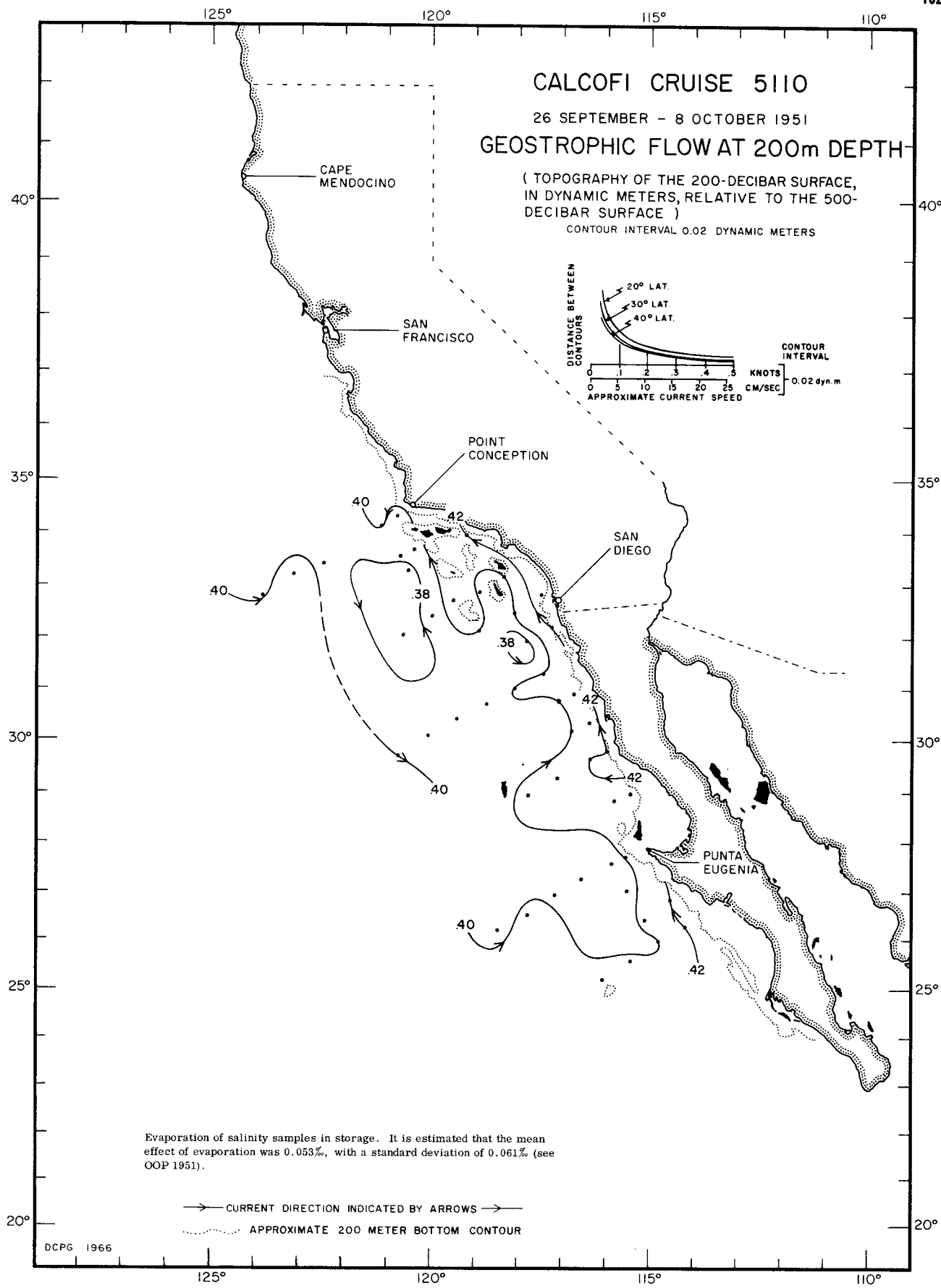


200/500 db  
5107

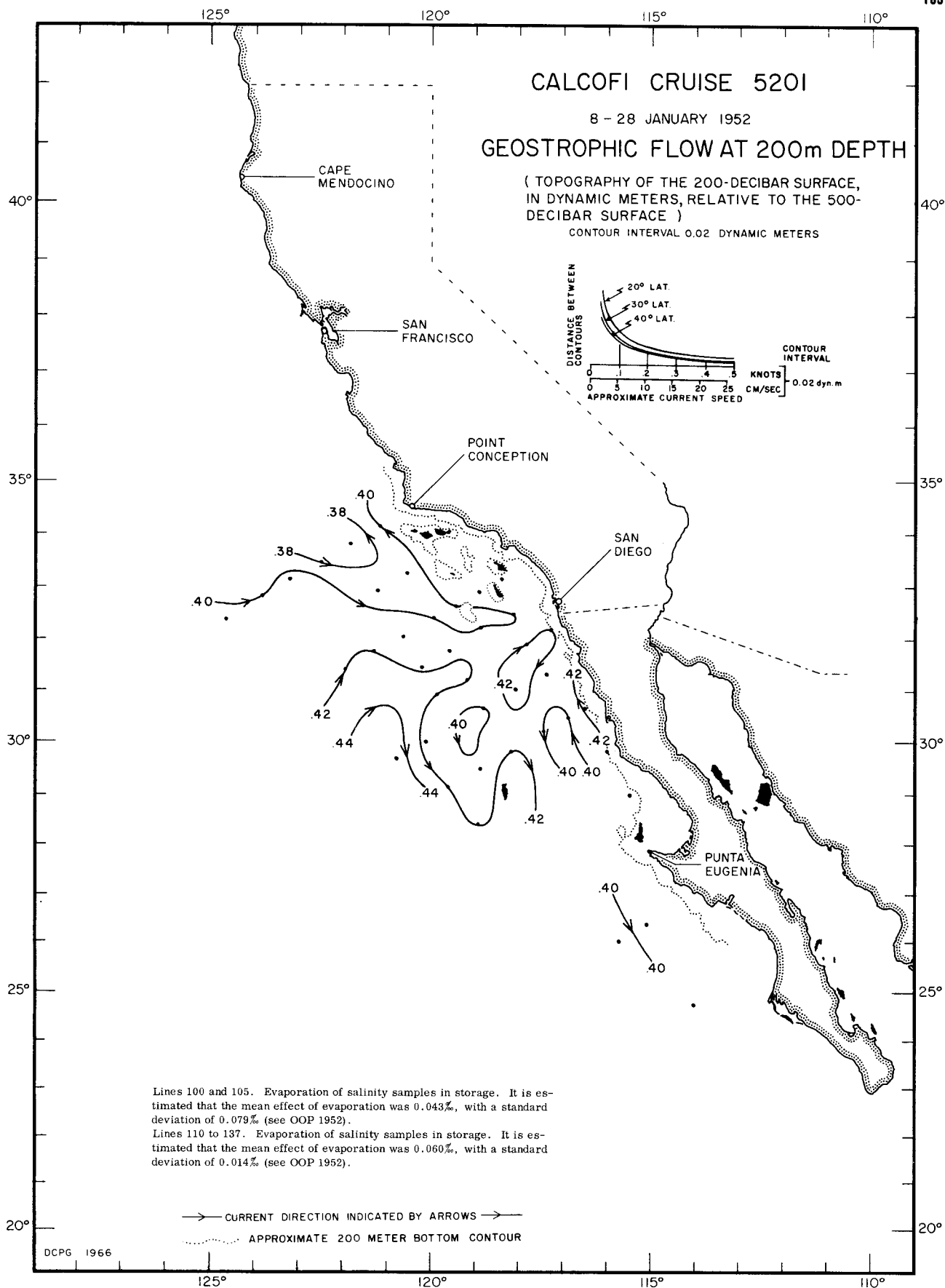


200/500 db  
5109



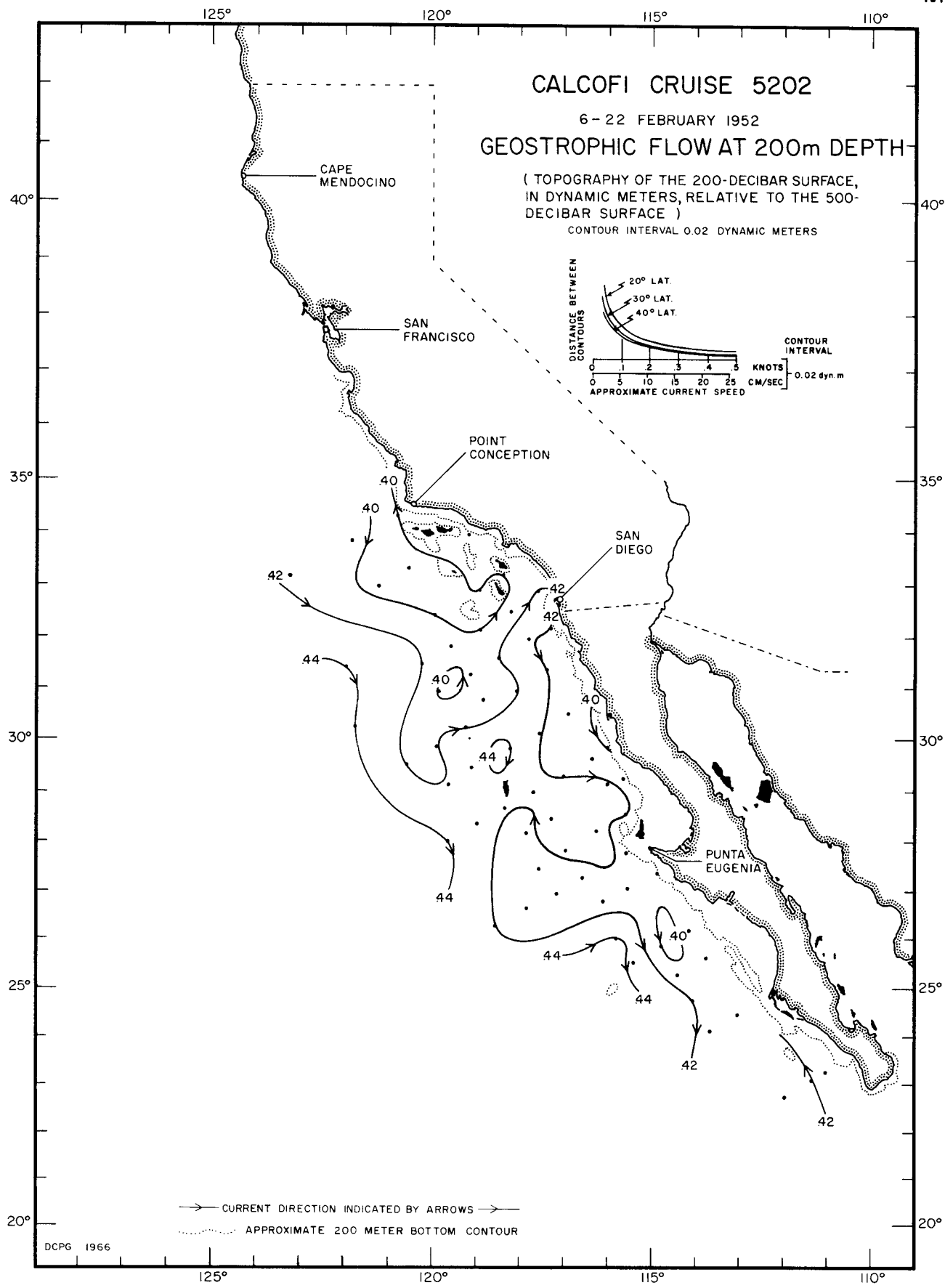


200/500 db  
5110

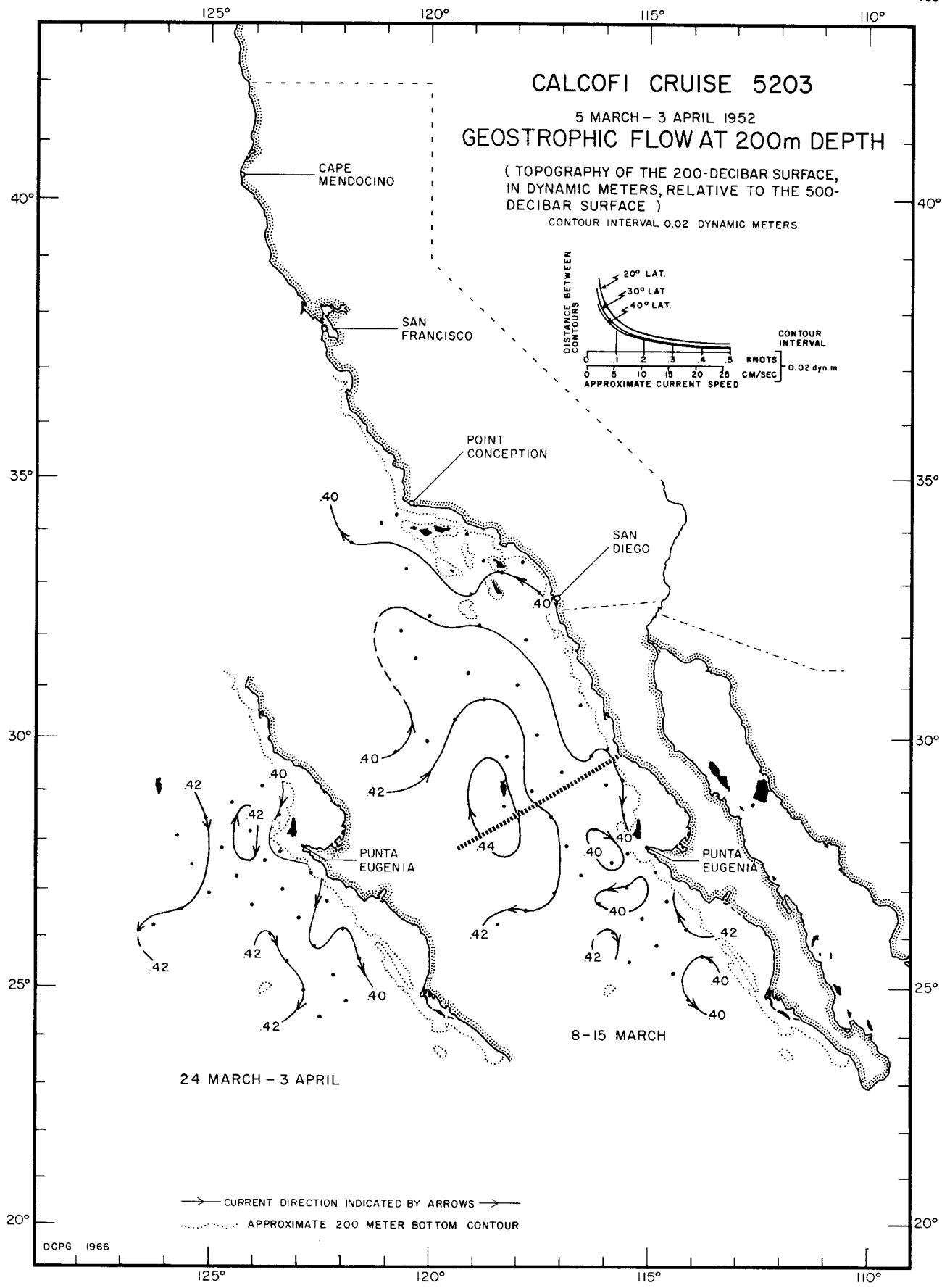


Lines 100 and 105. Evaporation of salinity samples in storage. It is estimated that the mean effect of evaporation was 0.043%, with a standard deviation of 0.079% (see OOP 1952).  
Lines 110 to 137. Evaporation of salinity samples in storage. It is estimated that the mean effect of evaporation was 0.060%, with a standard deviation of 0.014% (see OOP 1952).

200/500 db  
5201

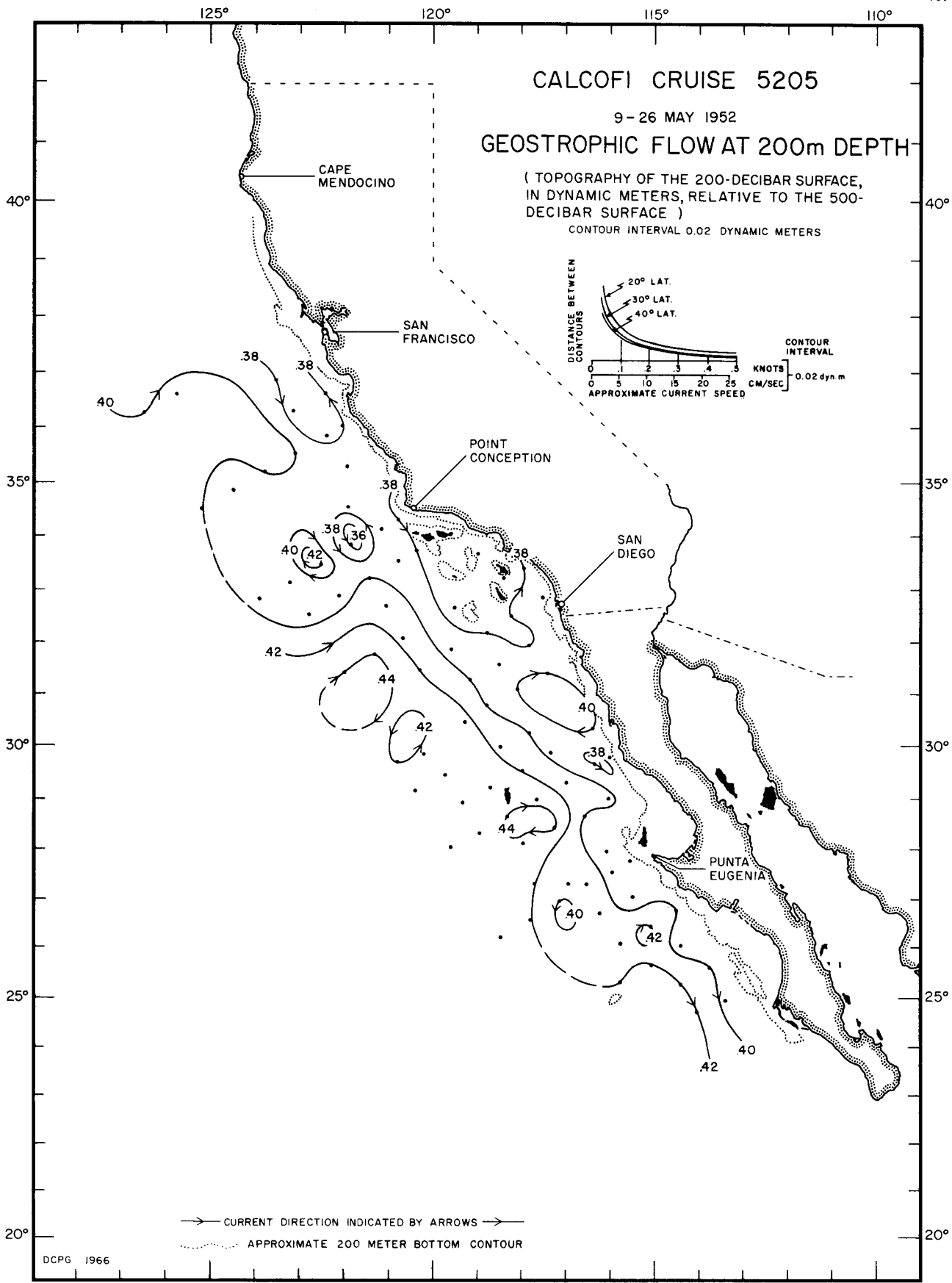


200/500 db  
5202

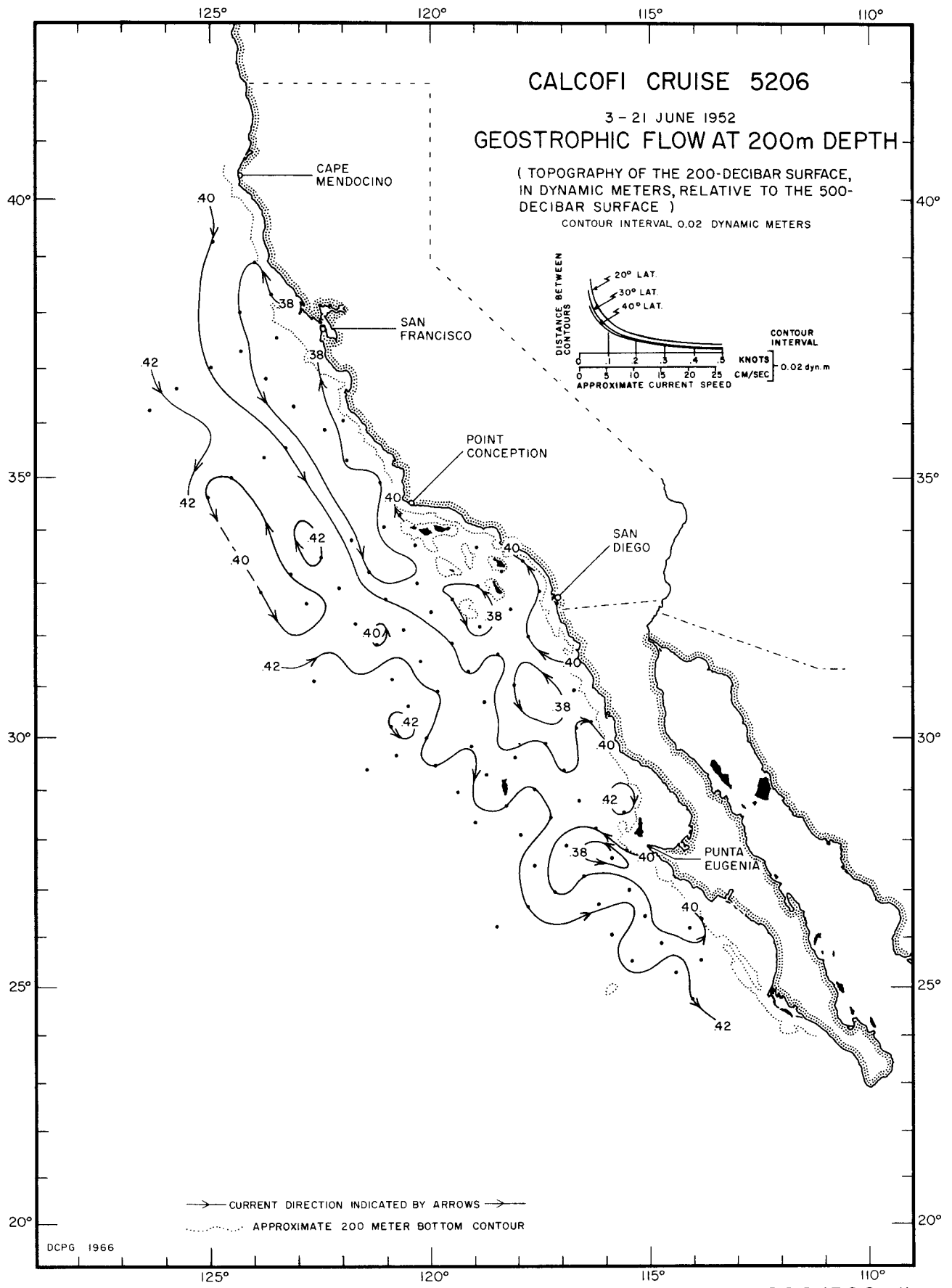


200/500 db  
5203



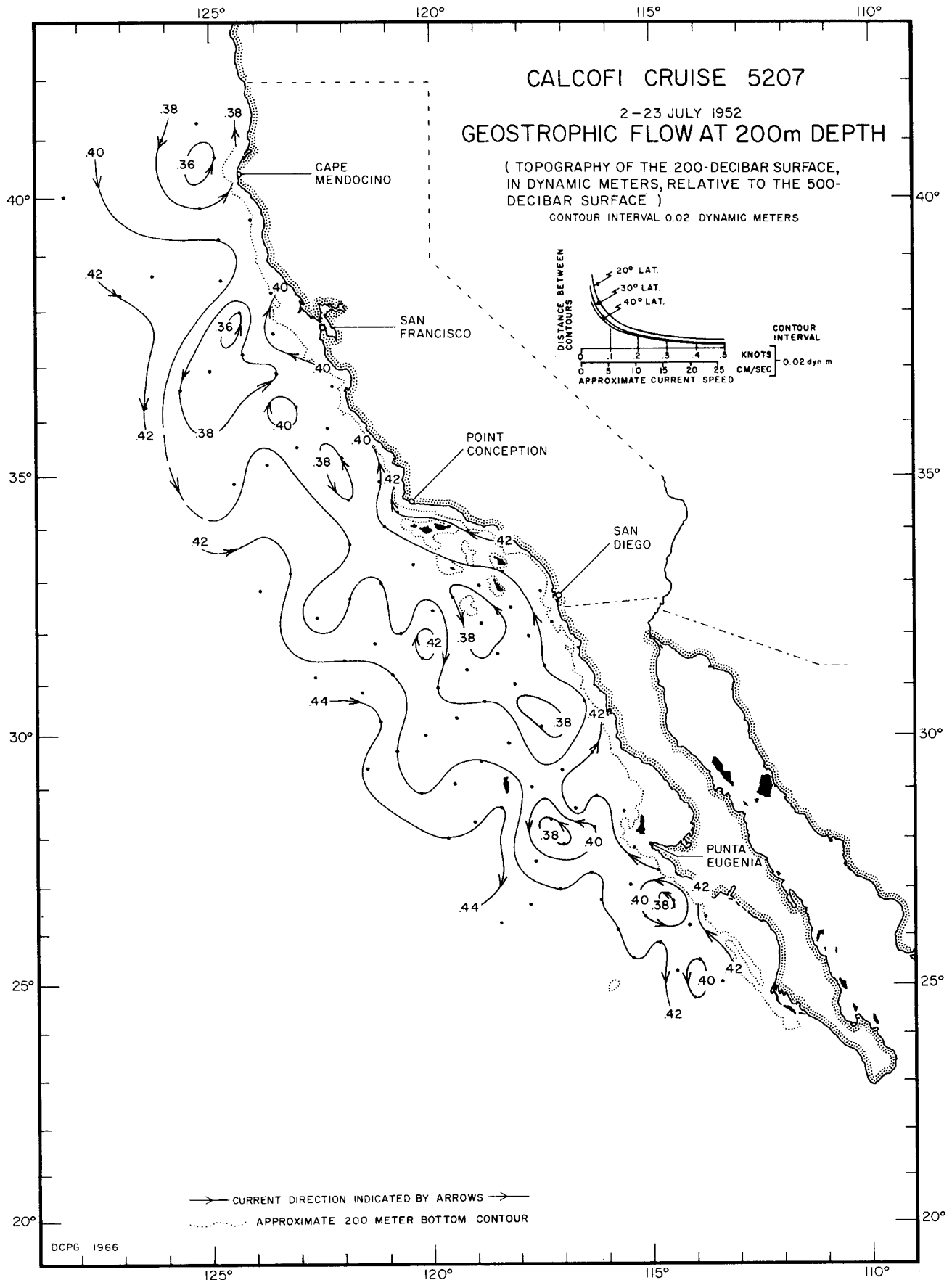


200/500 db  
5205



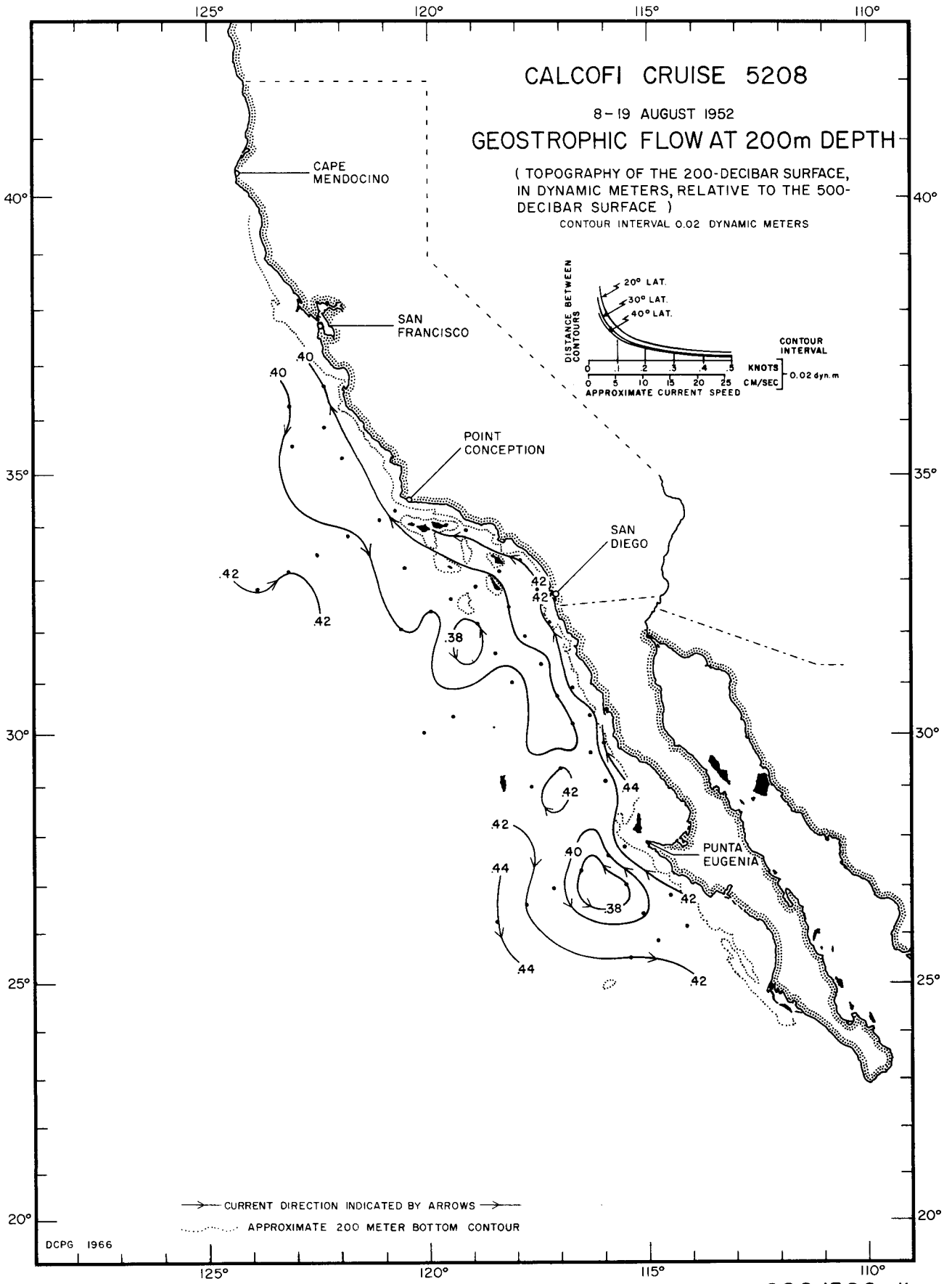
DCPG 1966

200/500 db  
5206

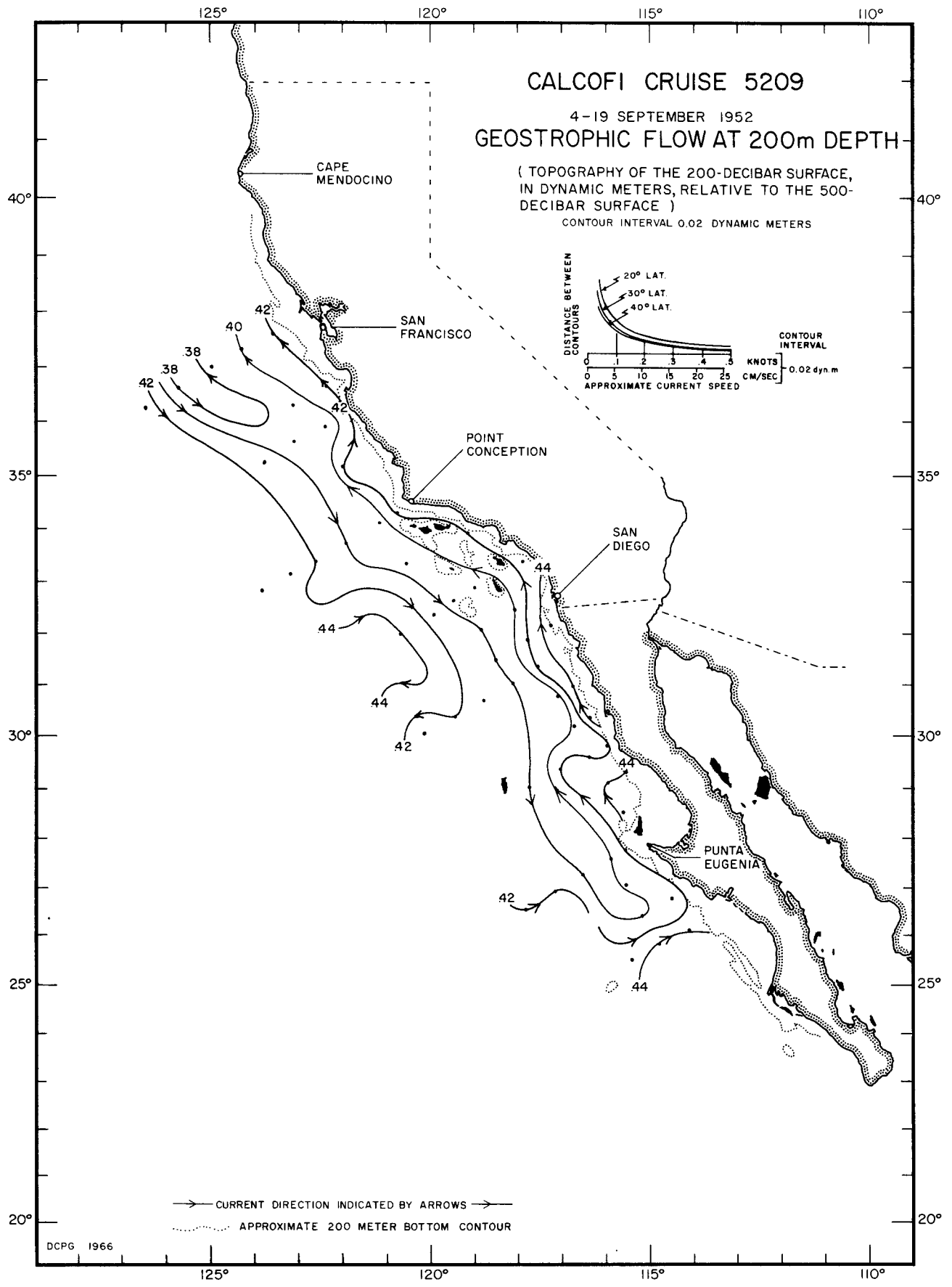


200/500 db  
5207

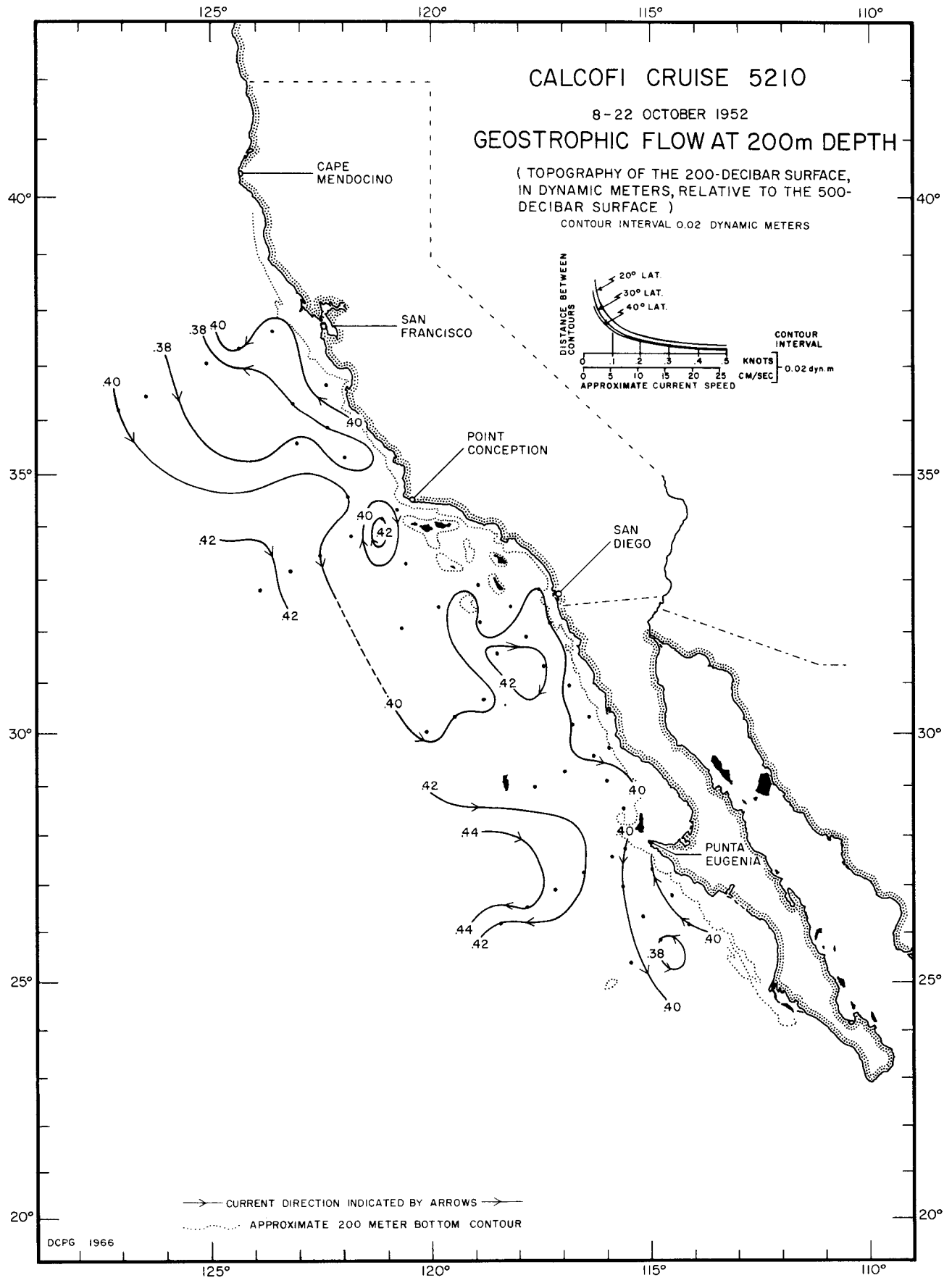




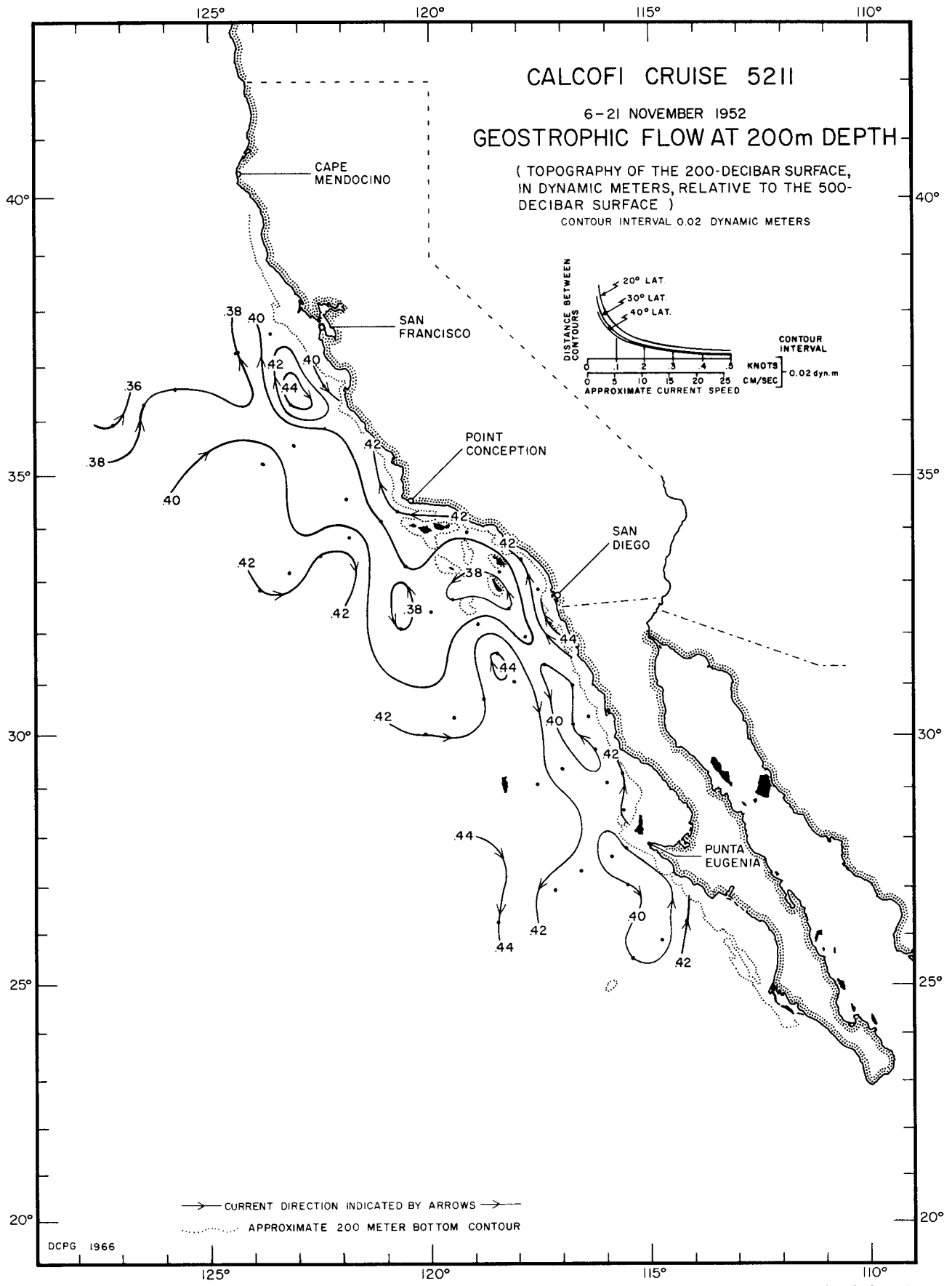
200/500 db  
5208

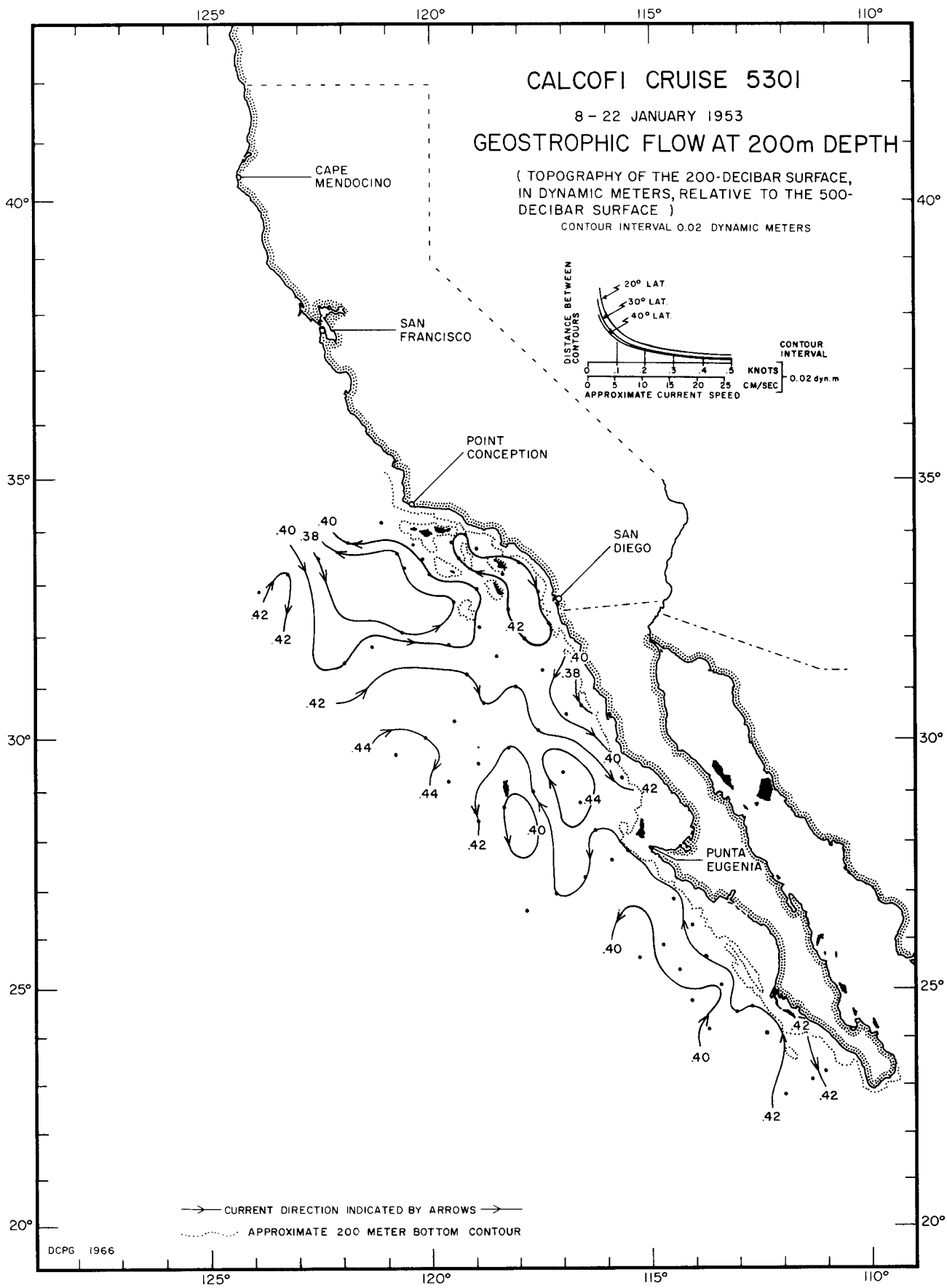


200/500 db  
5209

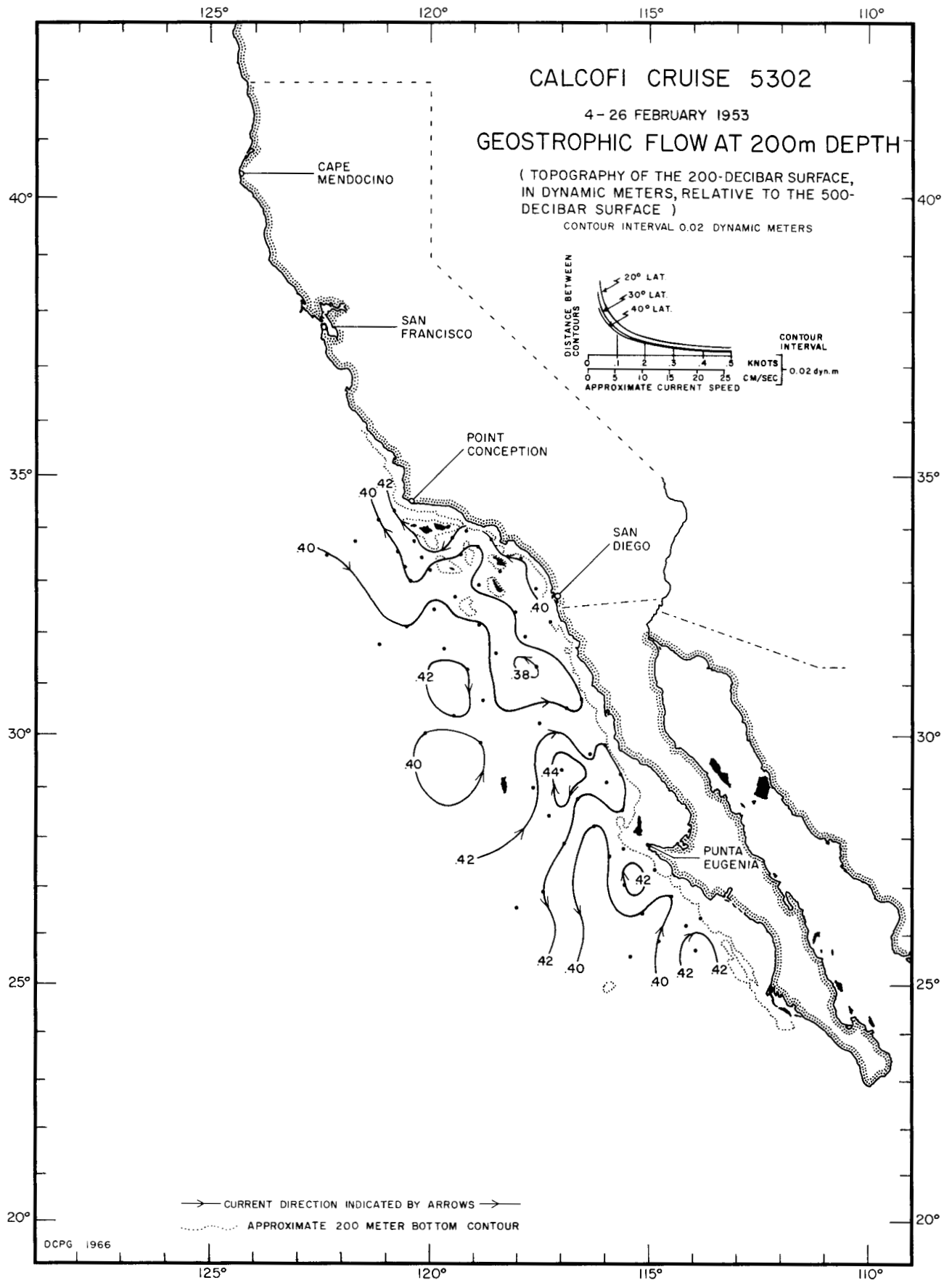


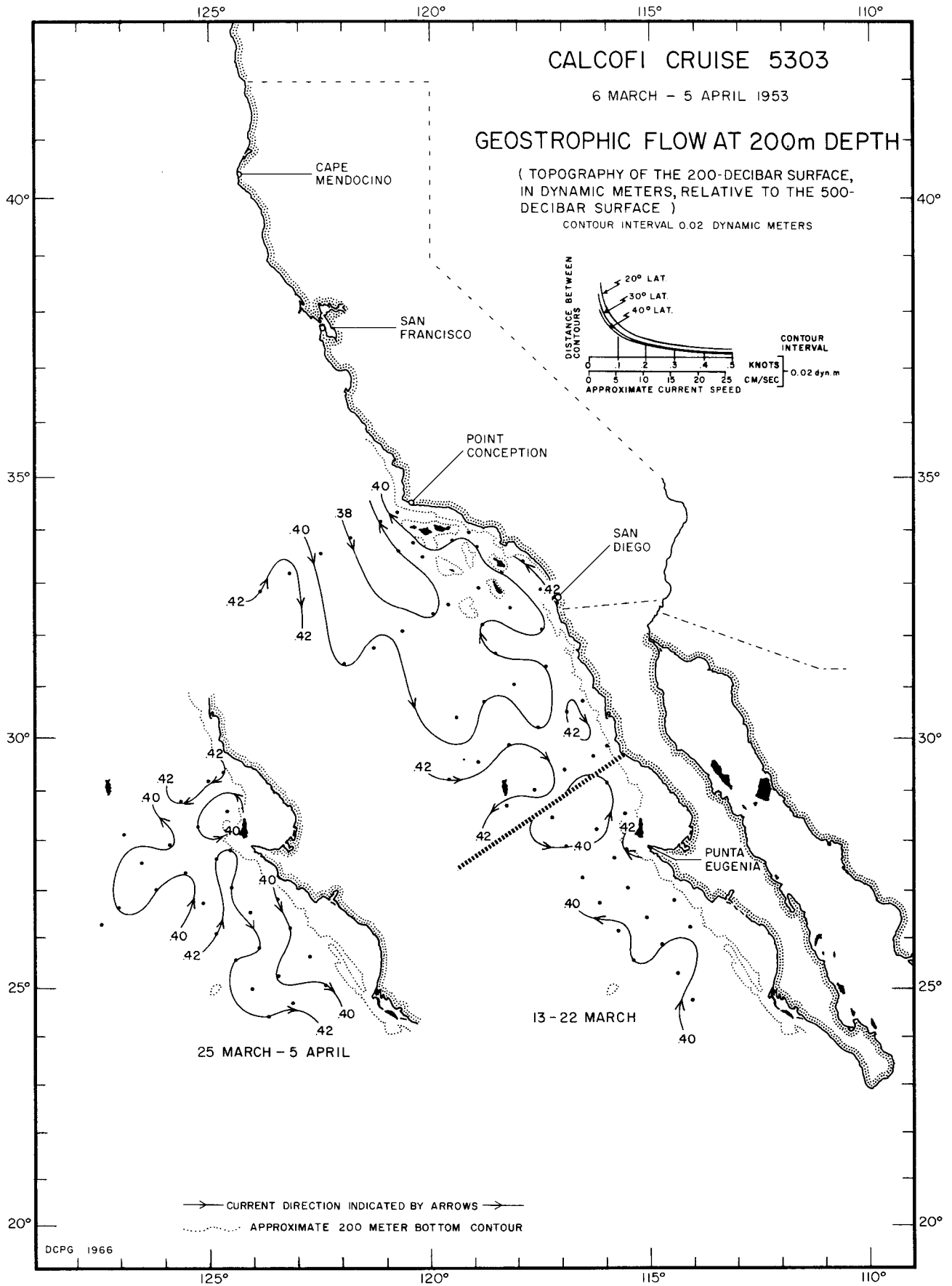
200/500 db  
5210



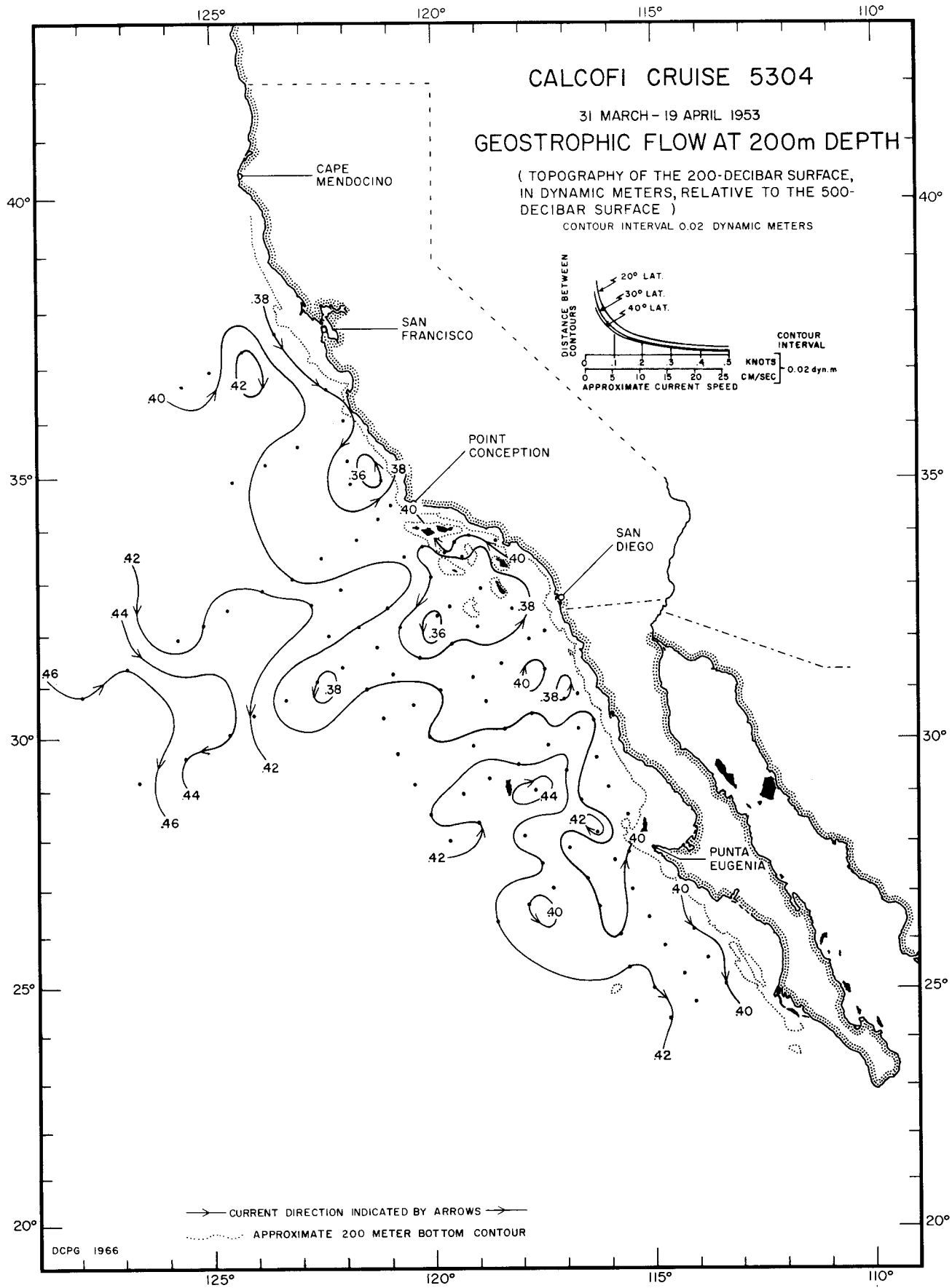


200/500 db  
5301



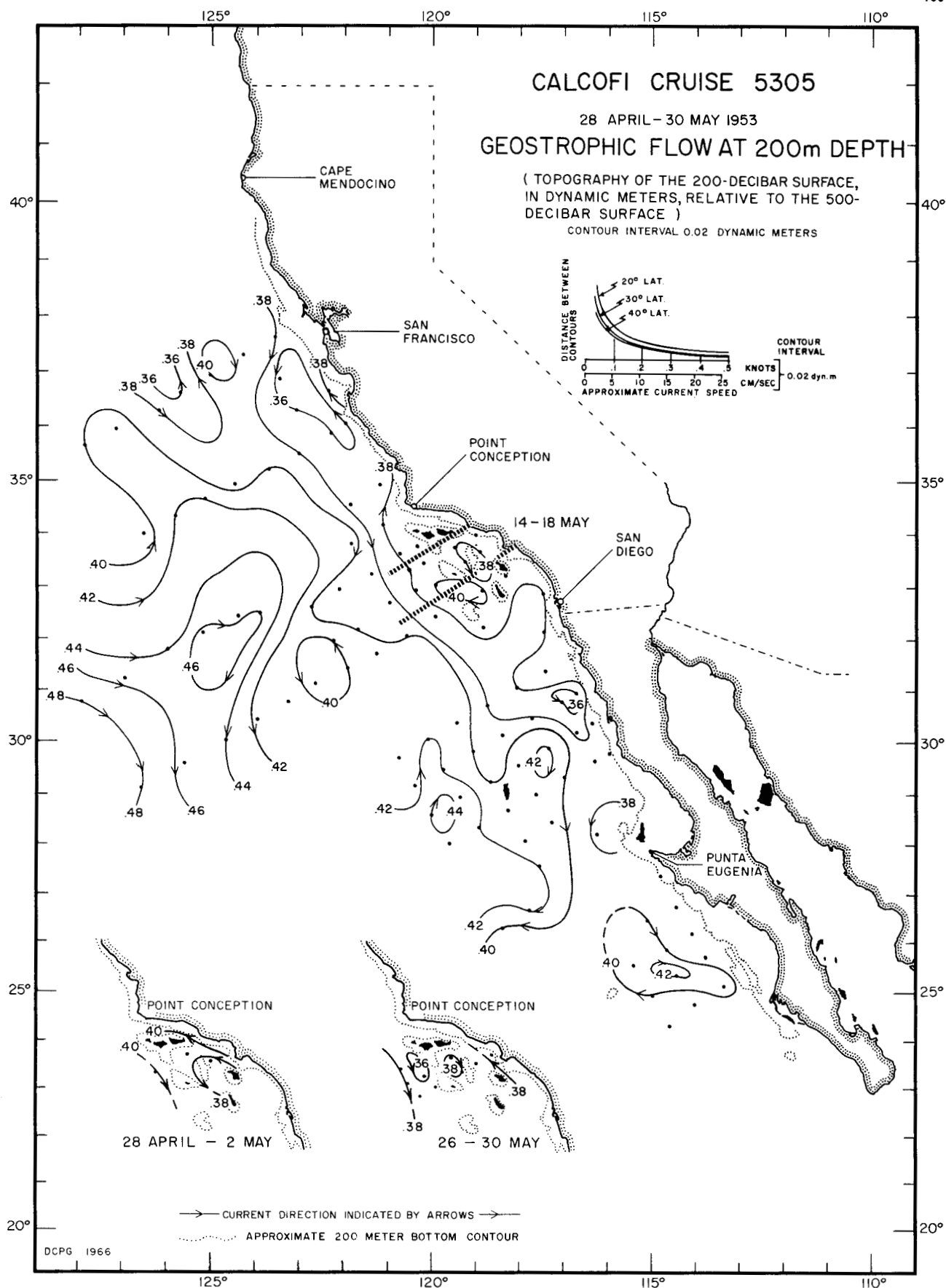


200/500 db  
5303



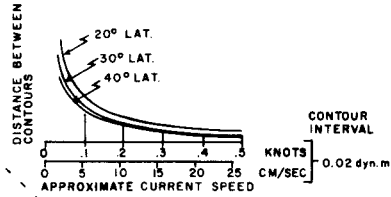
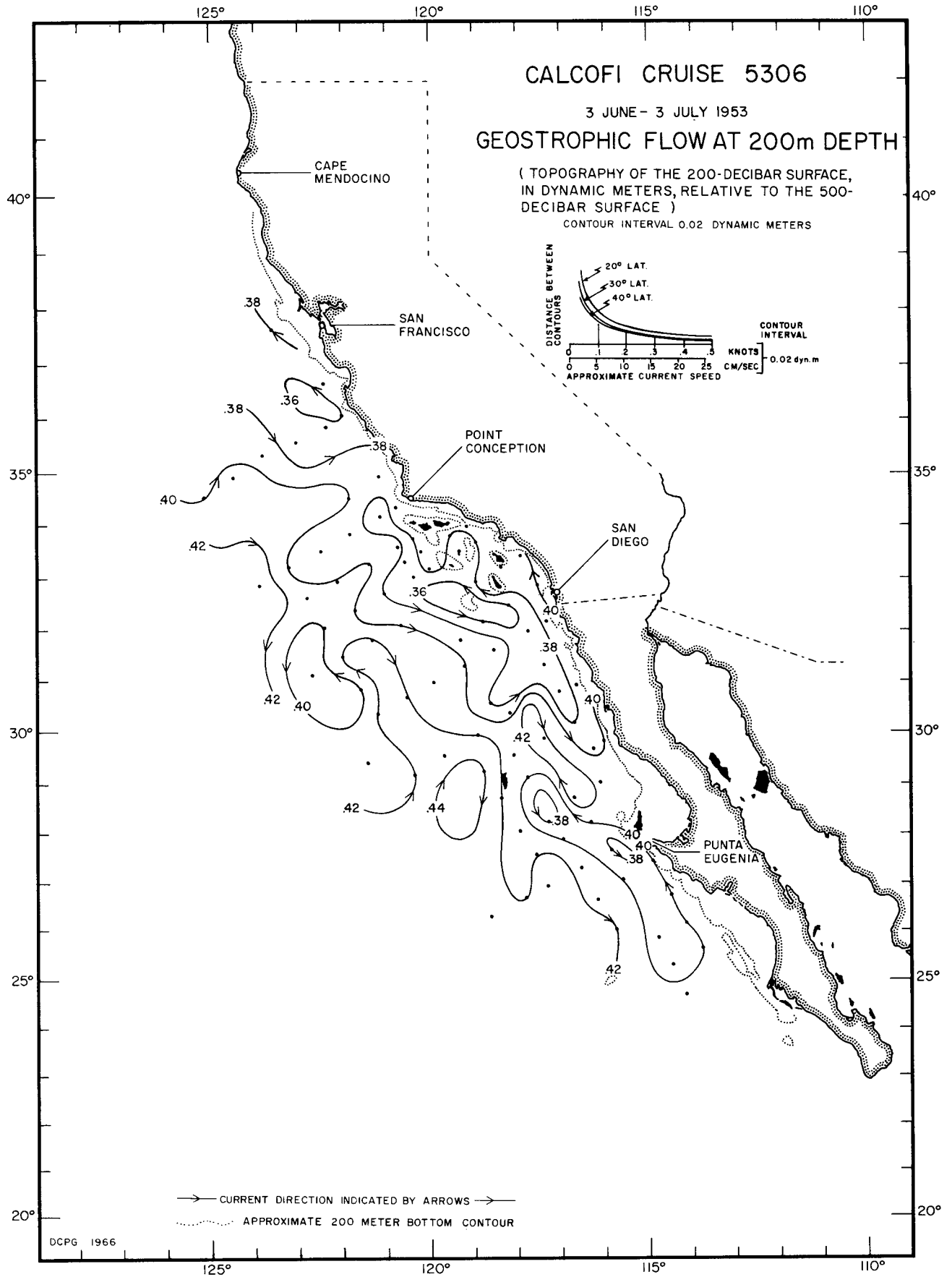
200/500 db  
5304

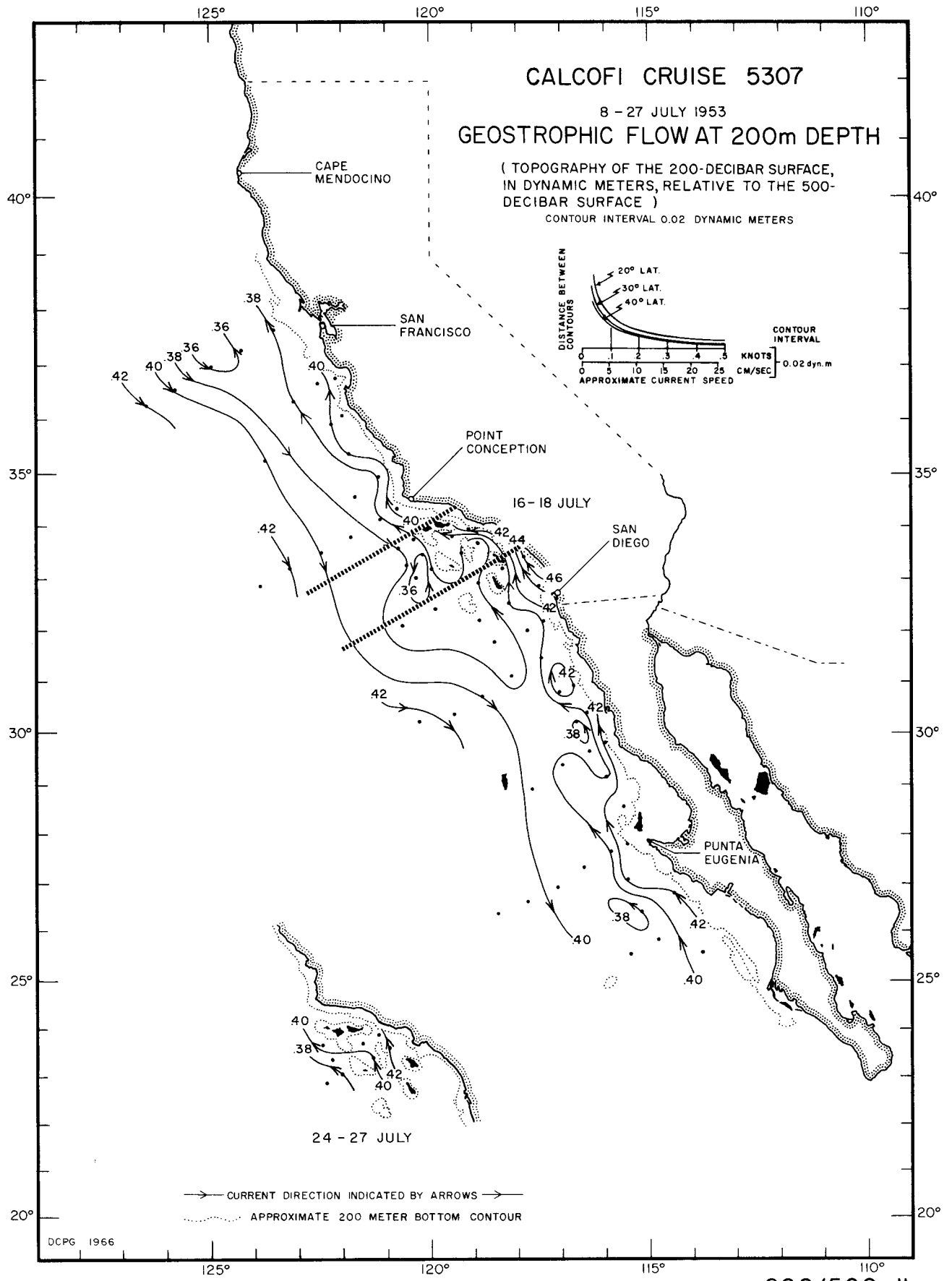




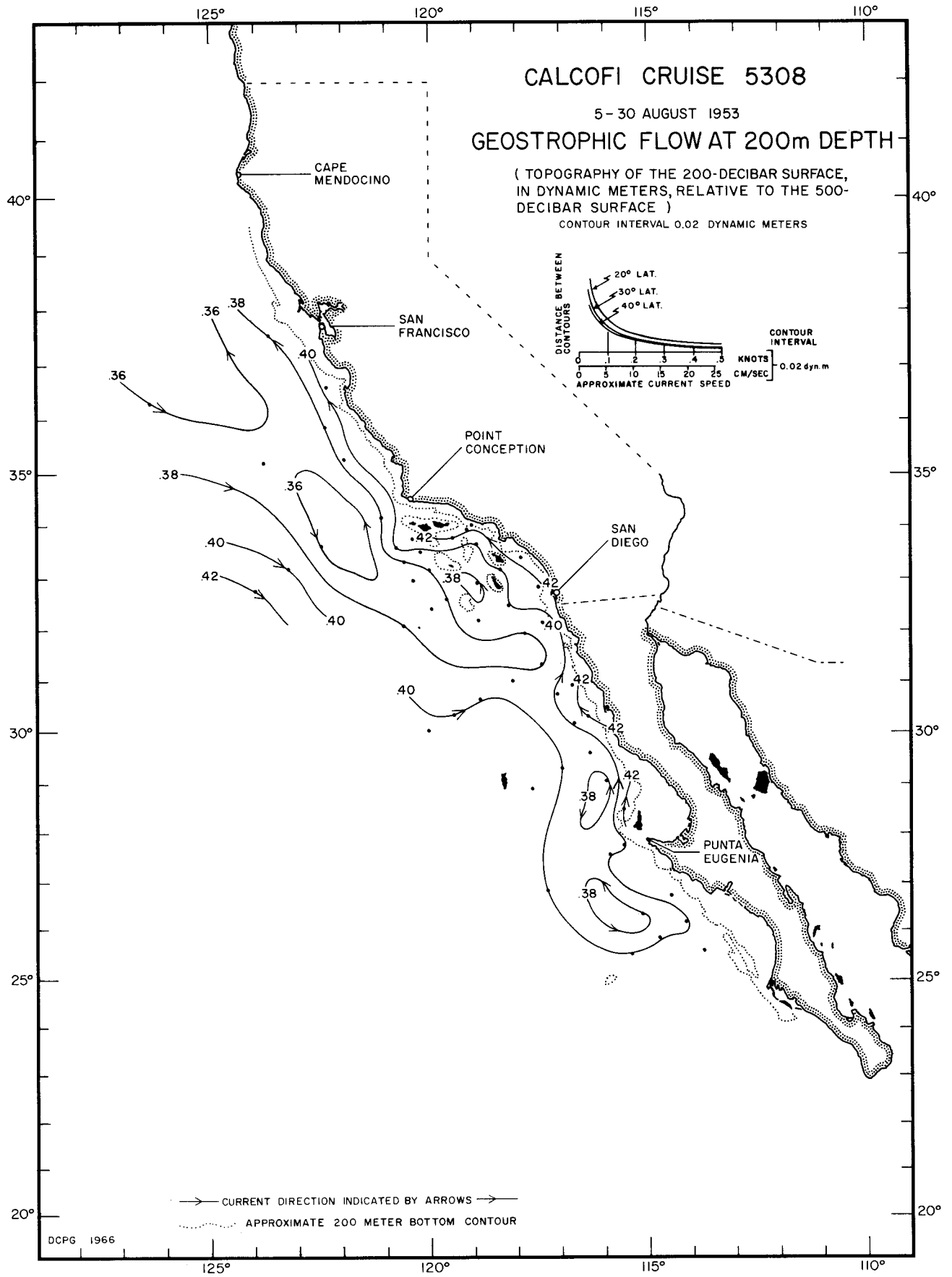
DCPG 1966

200/500 db  
5305

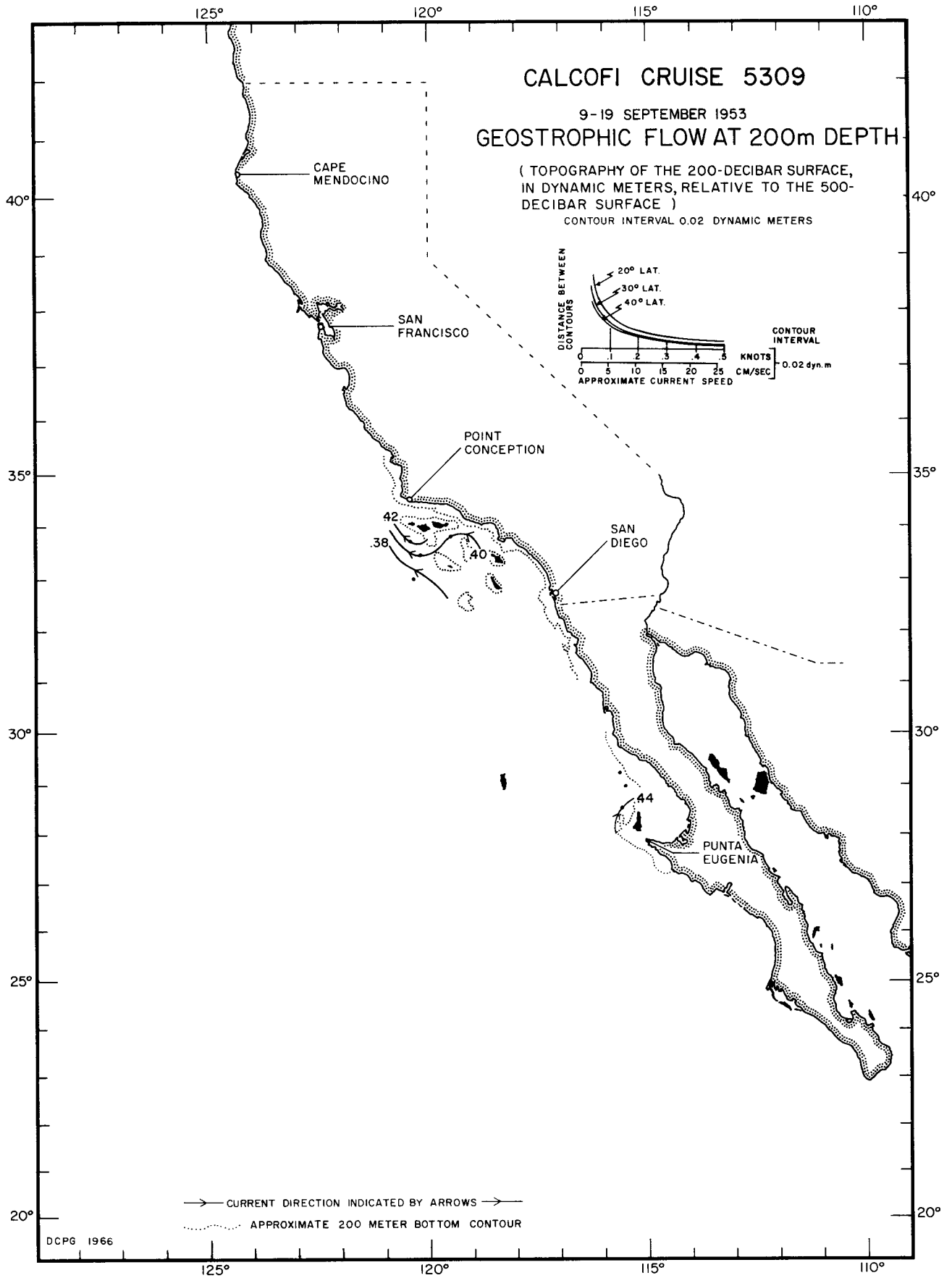




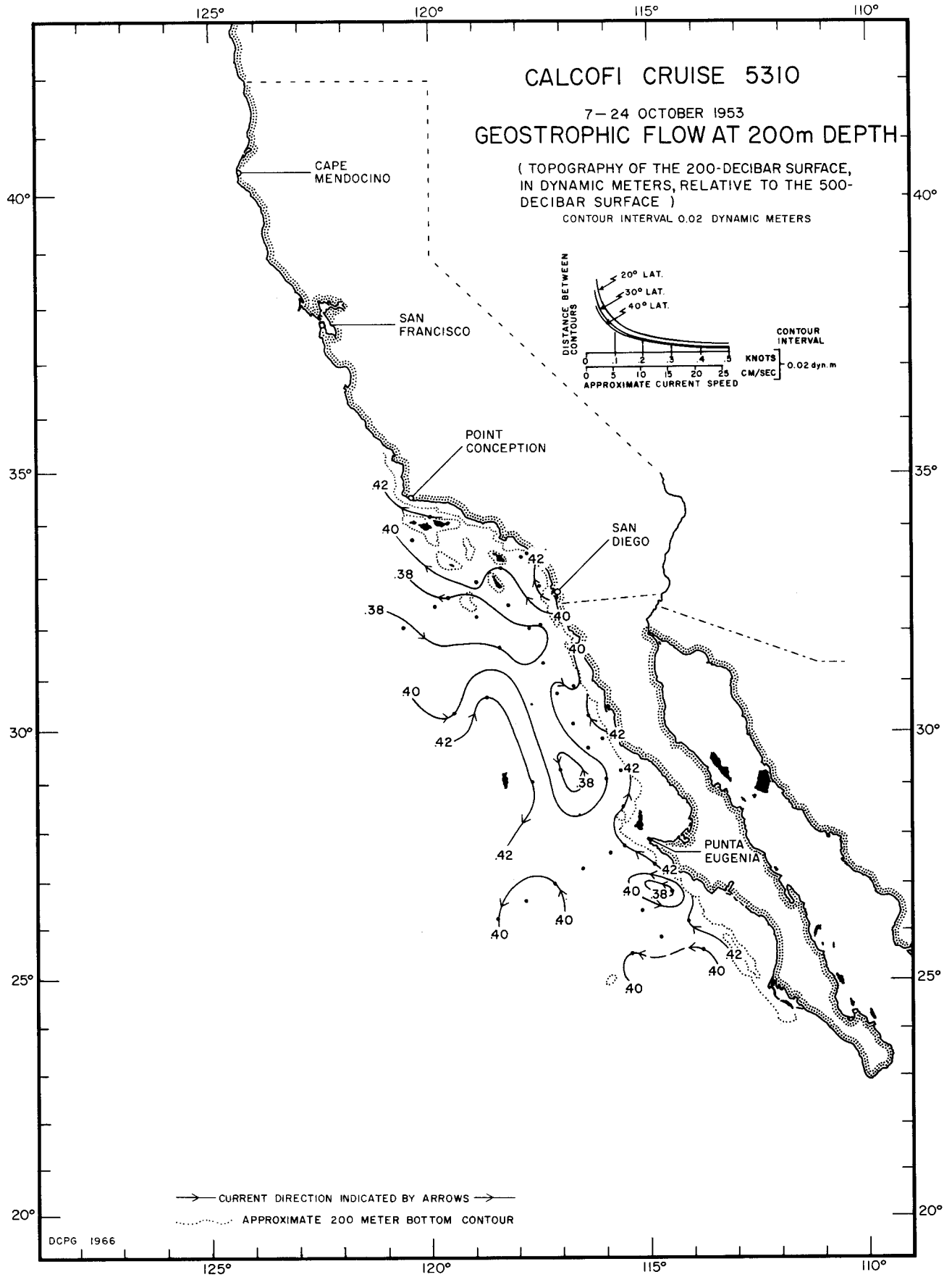
200/500 db  
5307



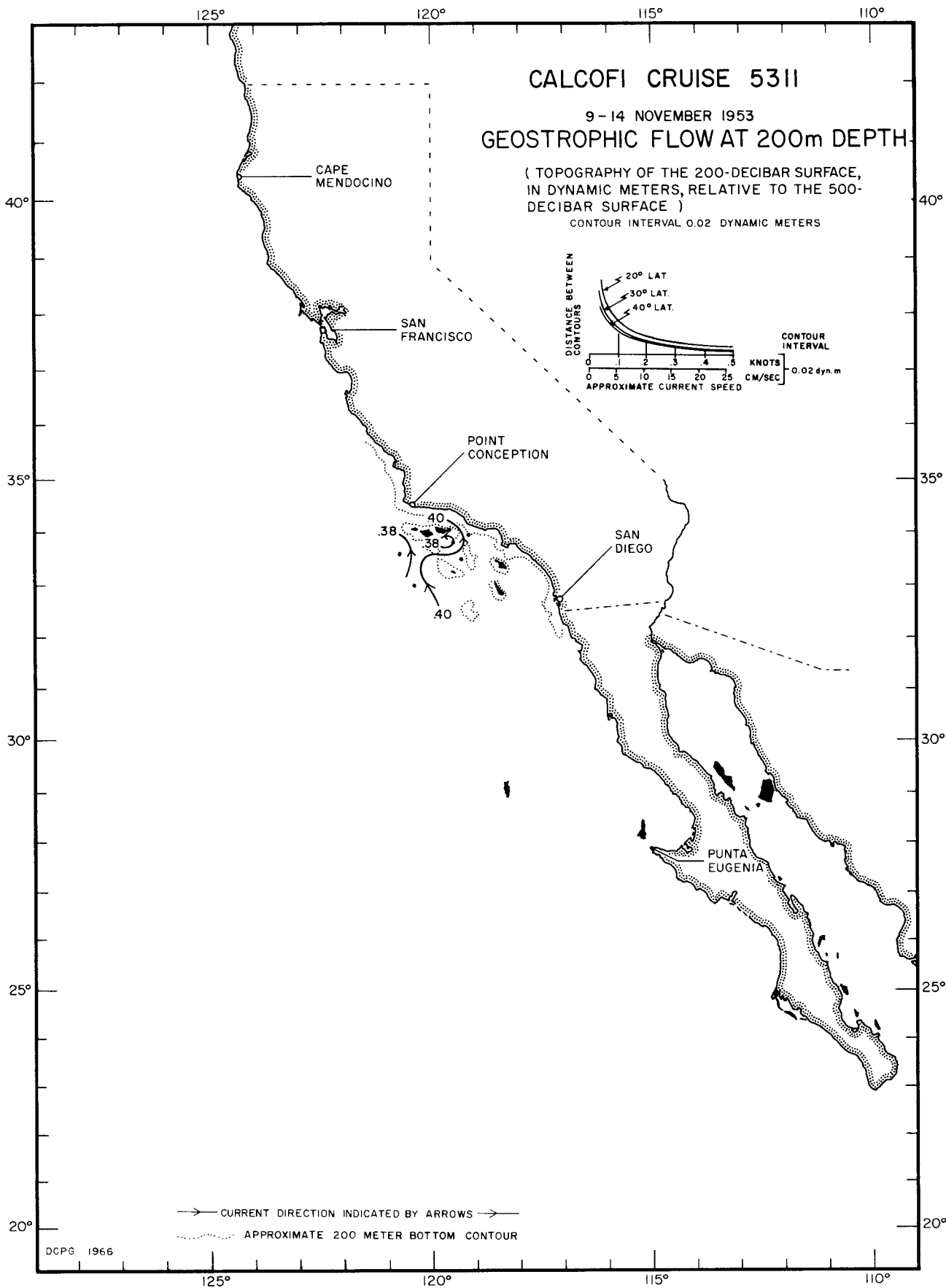
200/500 db  
5308



200/500 db  
5309

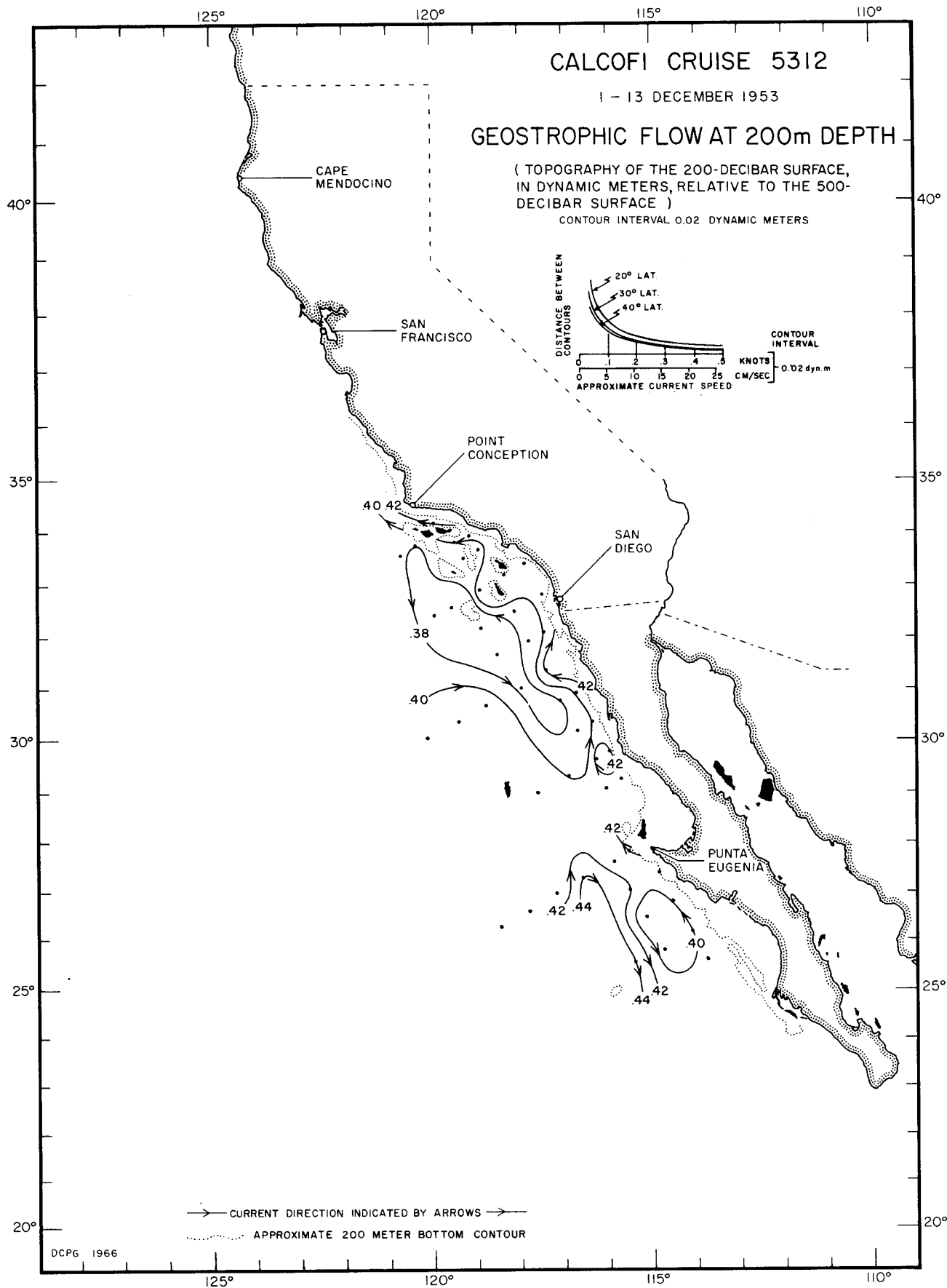


200/500 db  
5310

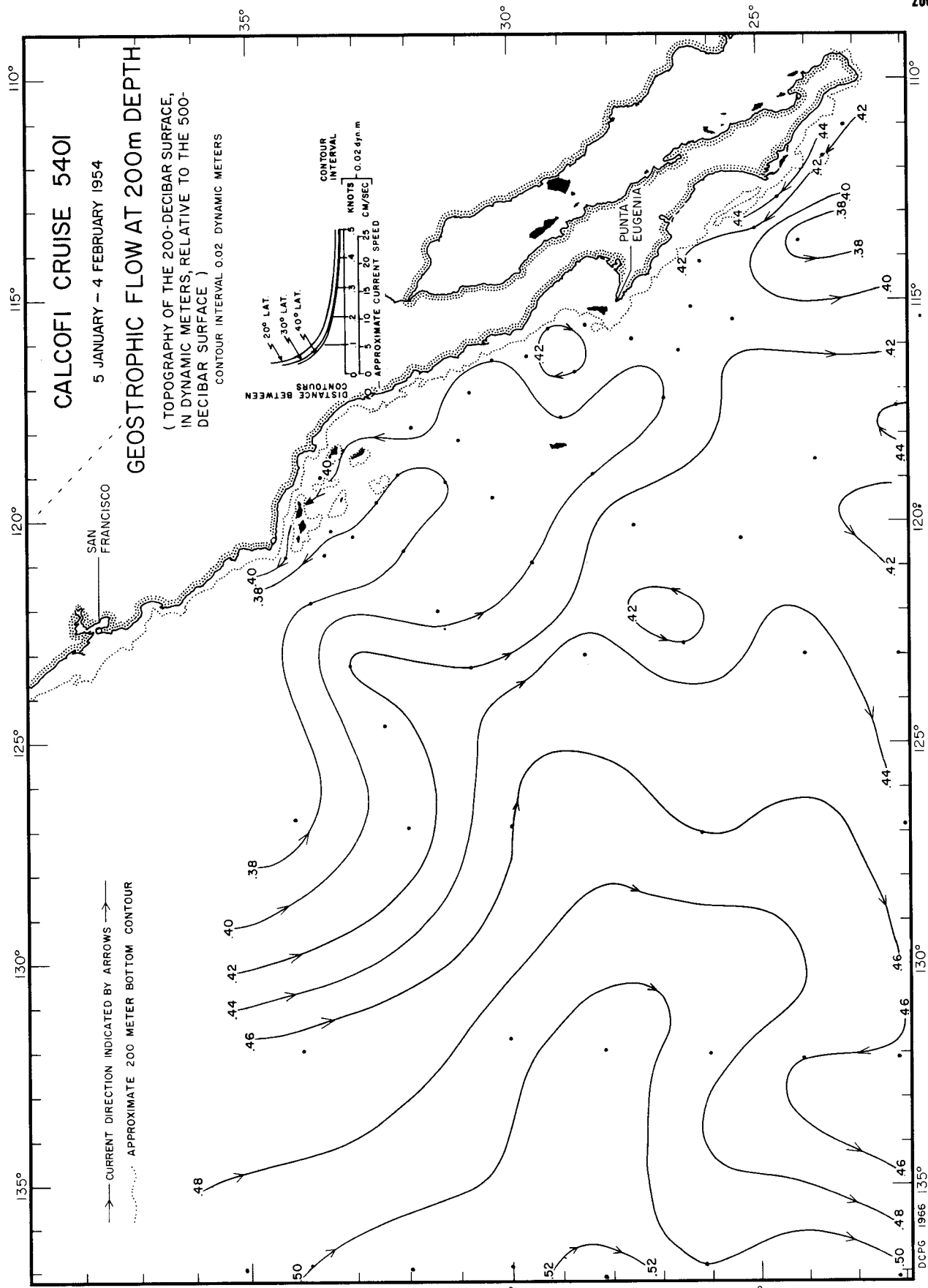


DCPG 1966

200/500 db  
5311

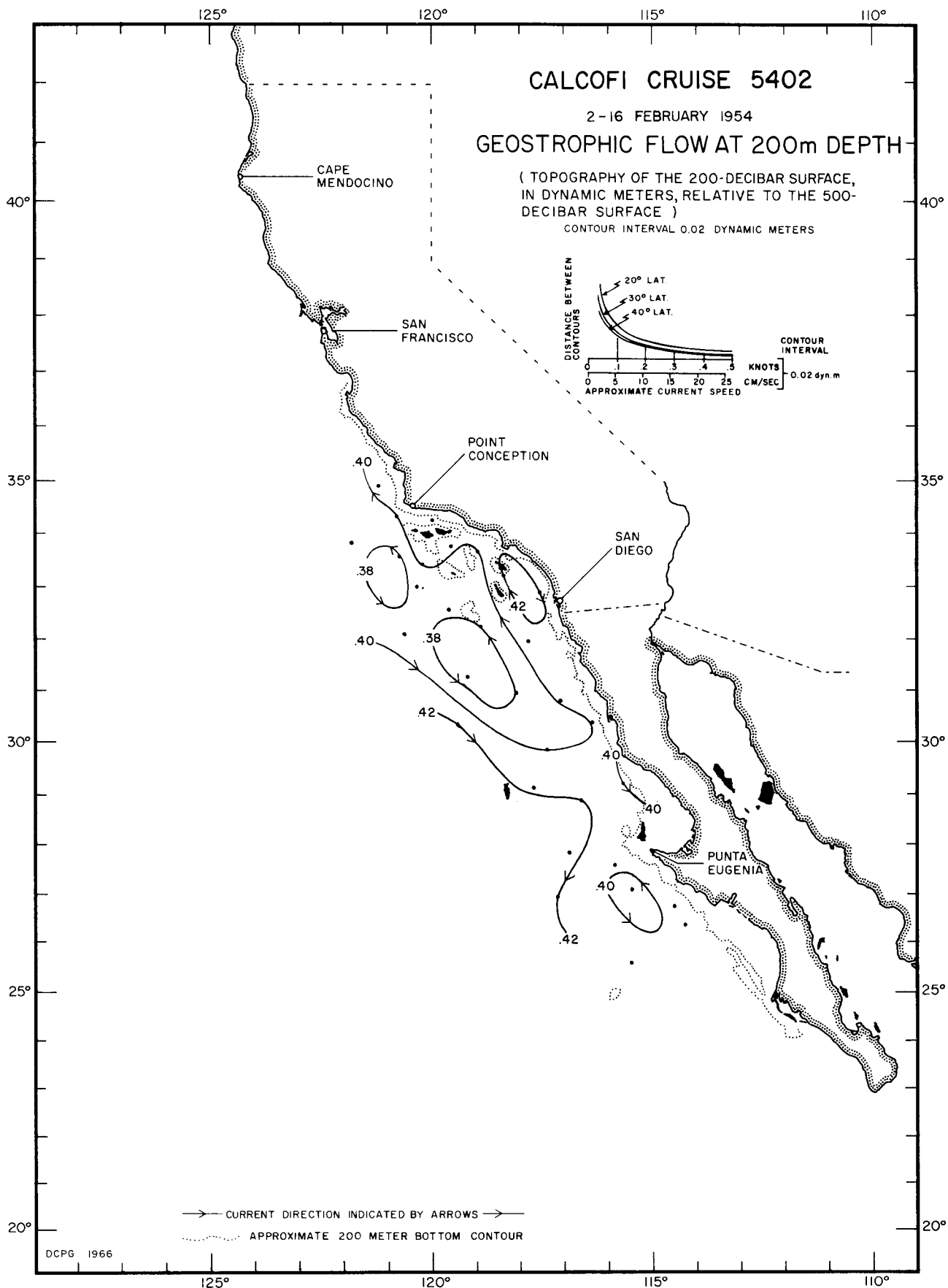






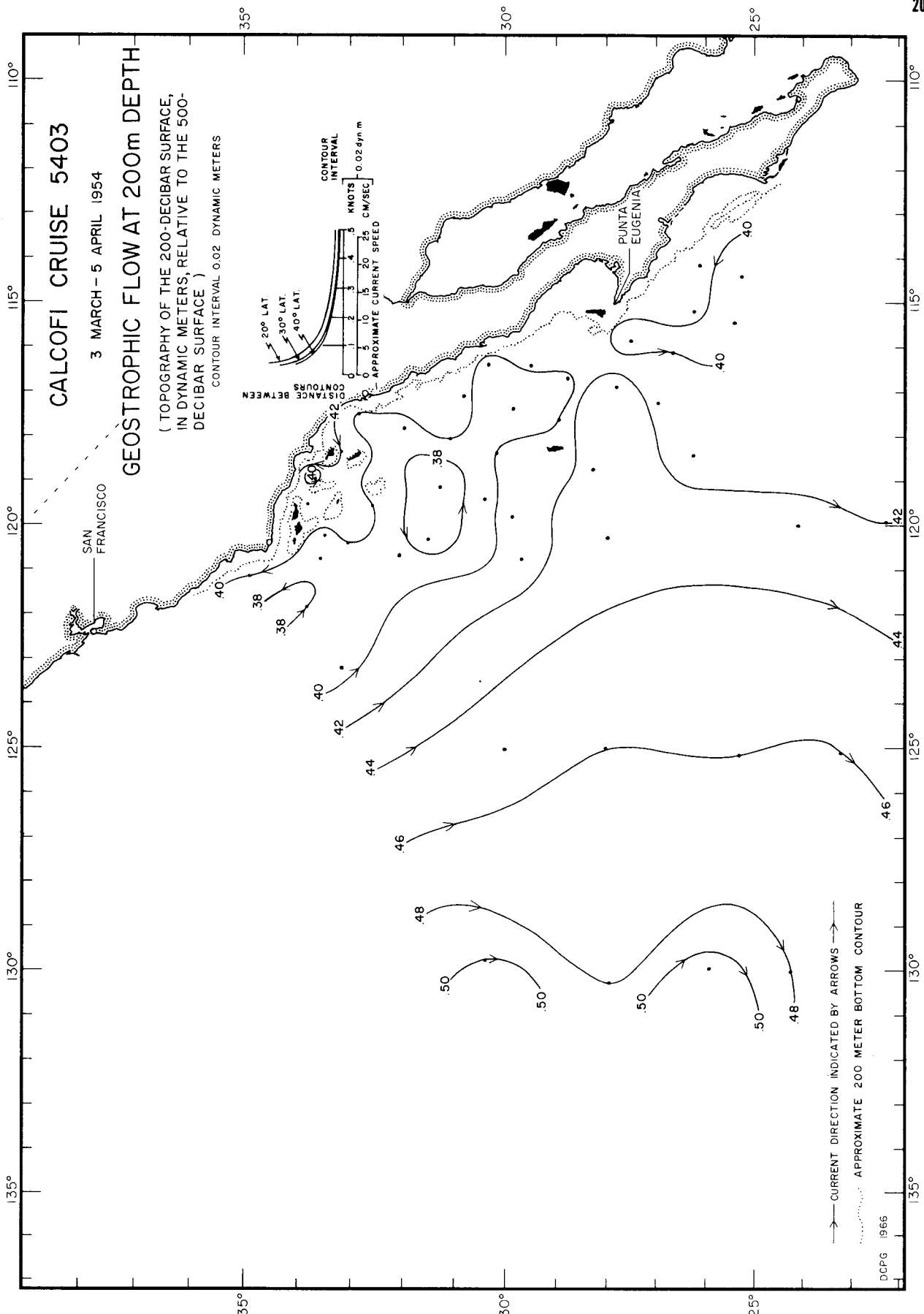
200/500 db  
 5401

DCFG 1966



DCPG 1966

200/500 db  
5402



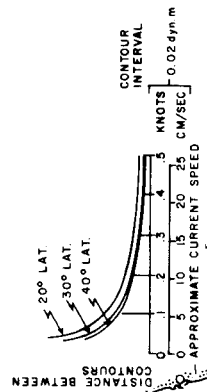
# CALCOFI CRUISE 5403

3 MARCH - 5 APRIL 1954

## GEOSTROPHIC FLOW AT 200m DEPTH

( TOPOGRAPHY OF THE 200-DECIBAR SURFACE, IN DYNAMIC METERS, RELATIVE TO THE 500-DECIBAR SURFACE. )

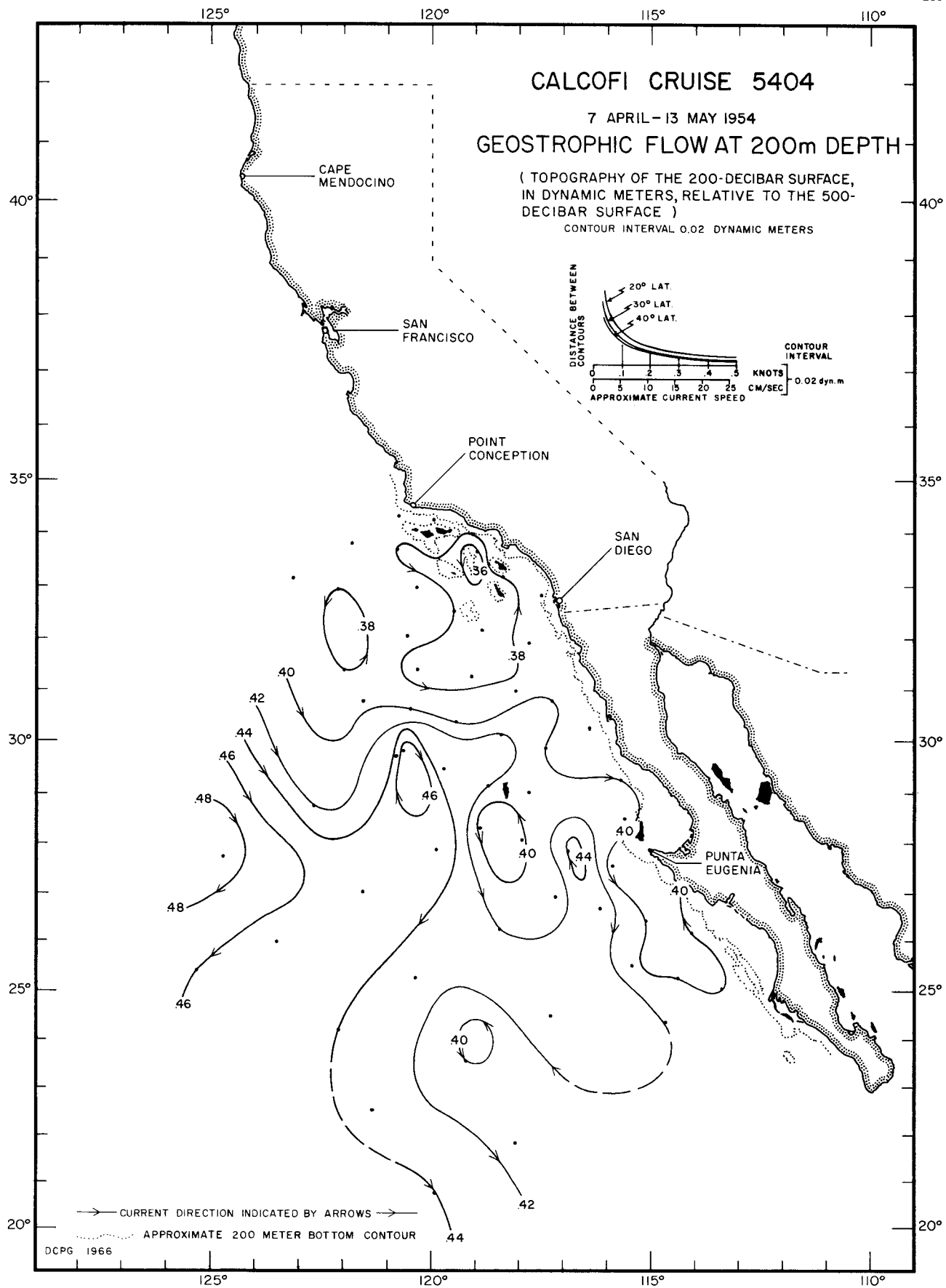
CONTOUR INTERVAL 0.02 DYNAMIC METERS

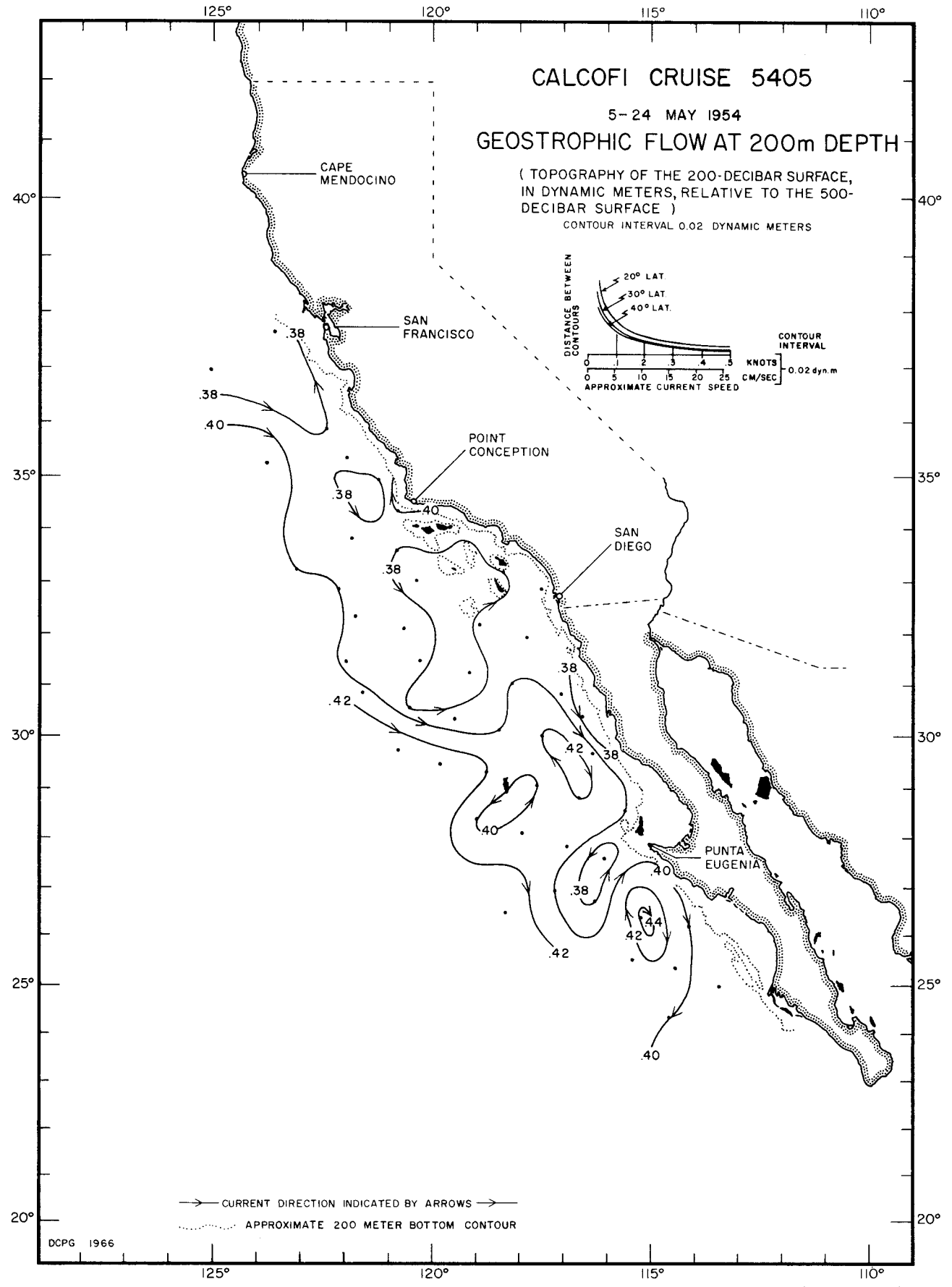


→ CURRENT DIRECTION INDICATED BY ARROWS →  
 ..... APPROXIMATE 200 METER BOTTOM CONTOUR

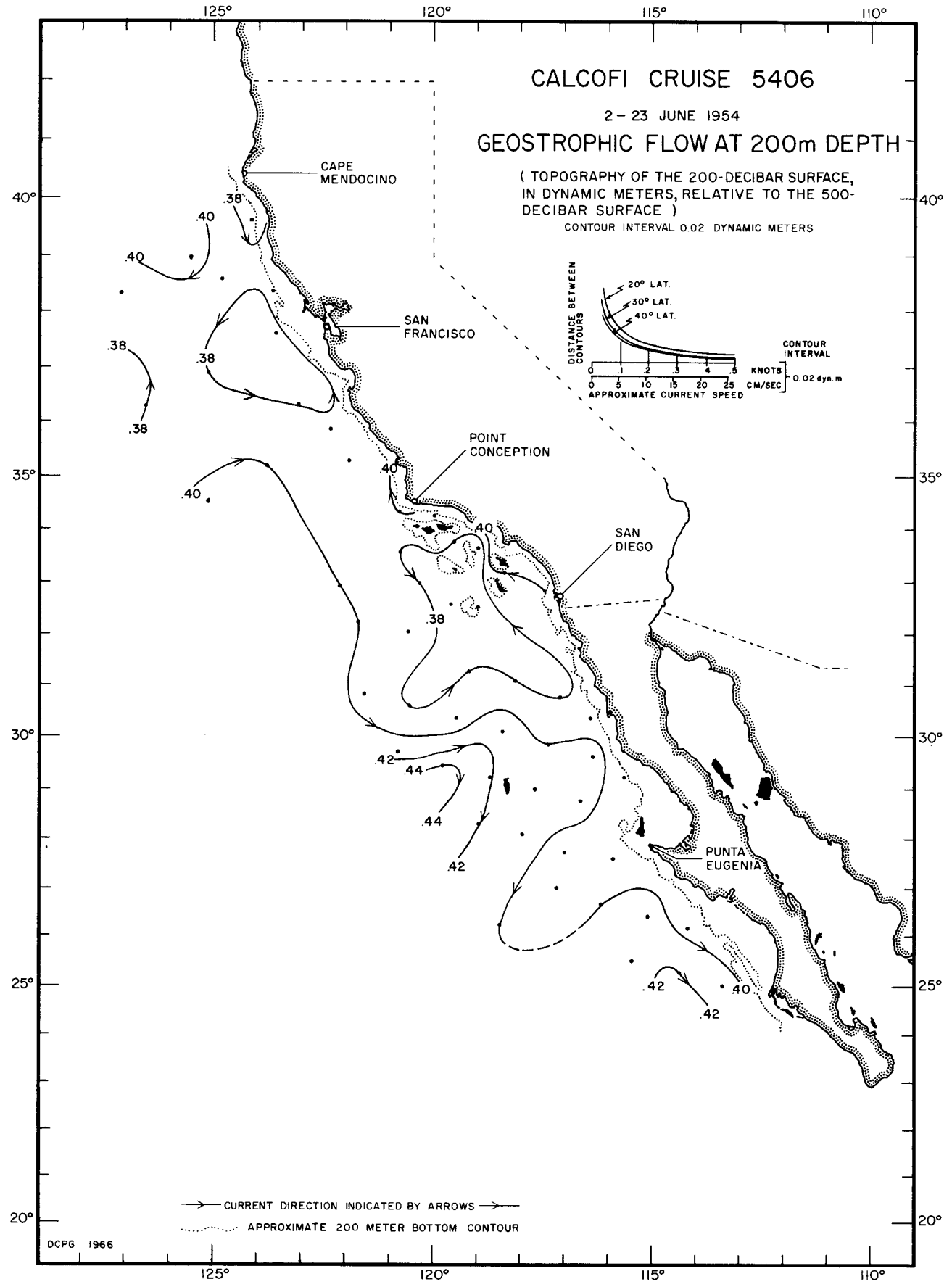
DCPG 1966

200/500 db  
5403

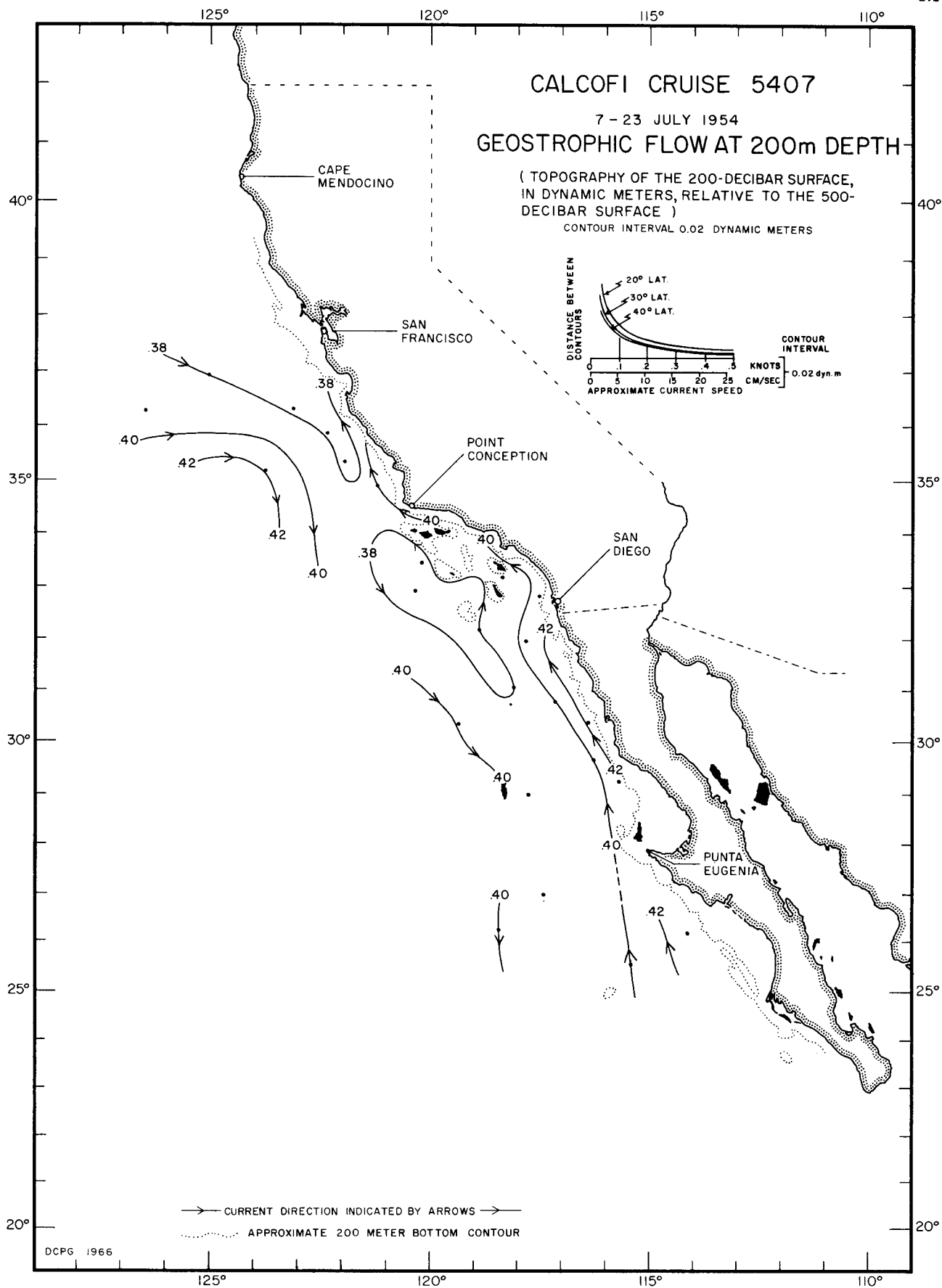




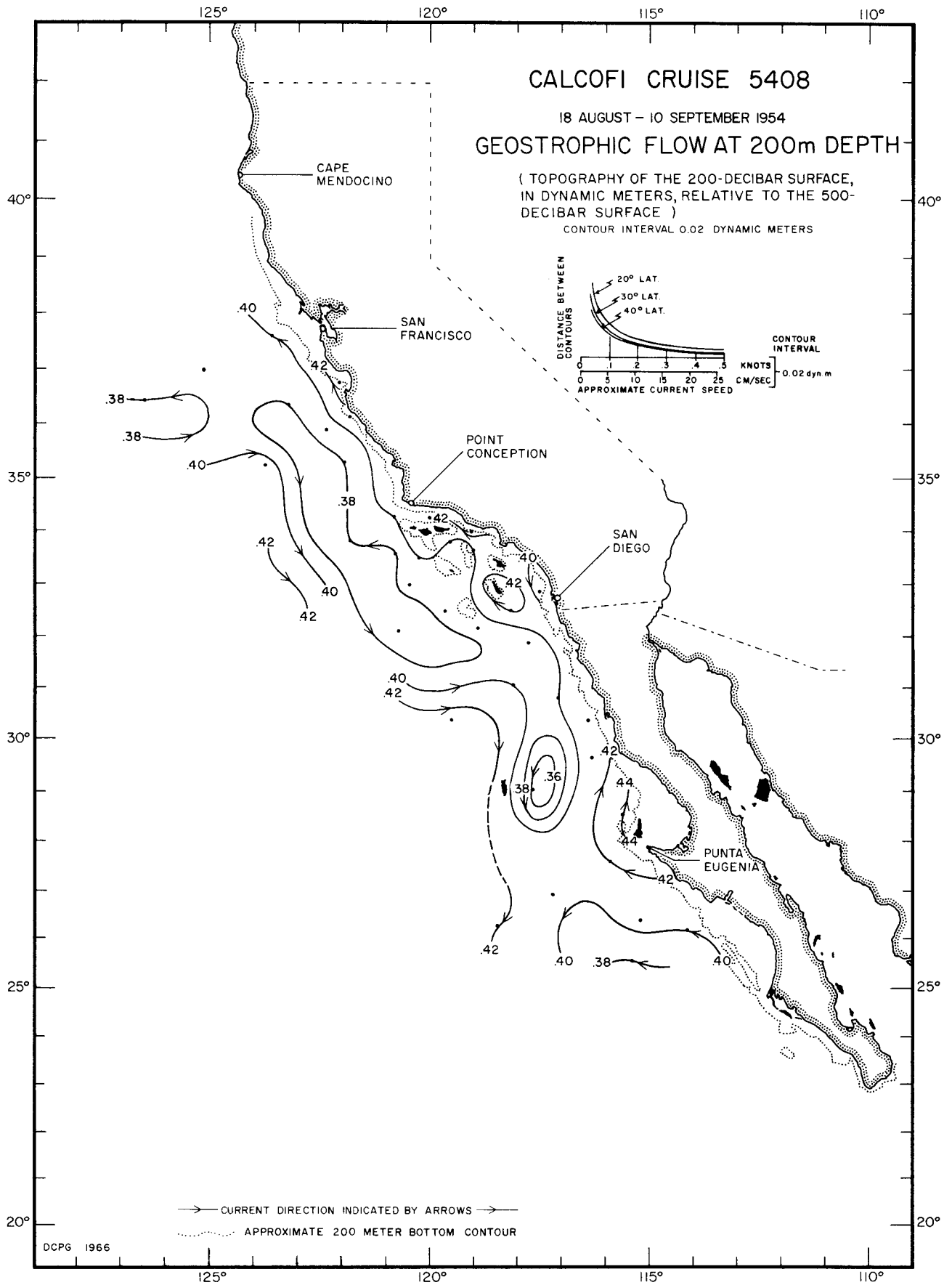
200/500 db  
5405



200/500 db  
5406



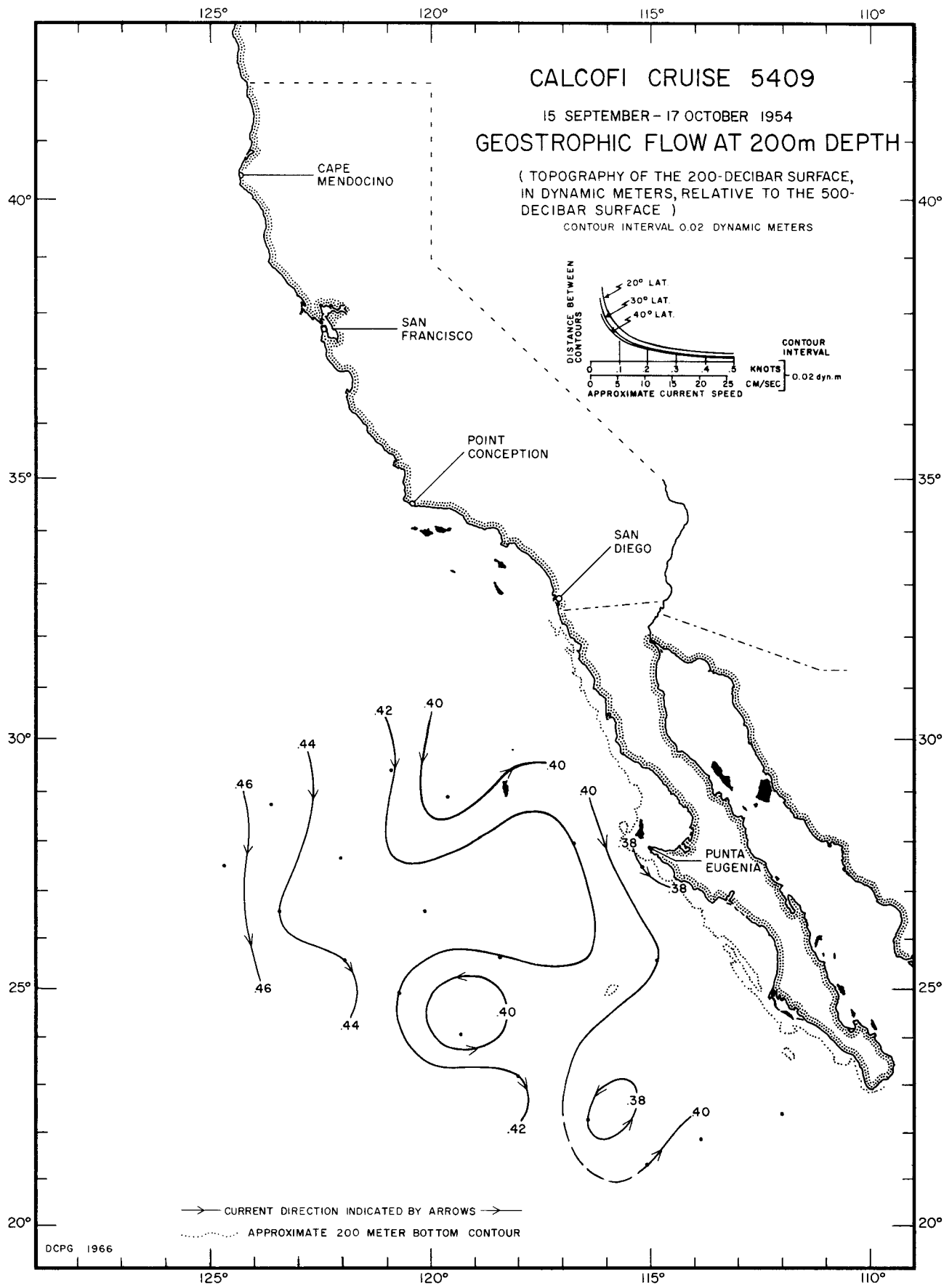
200/500 db  
5407



DCPG 1966

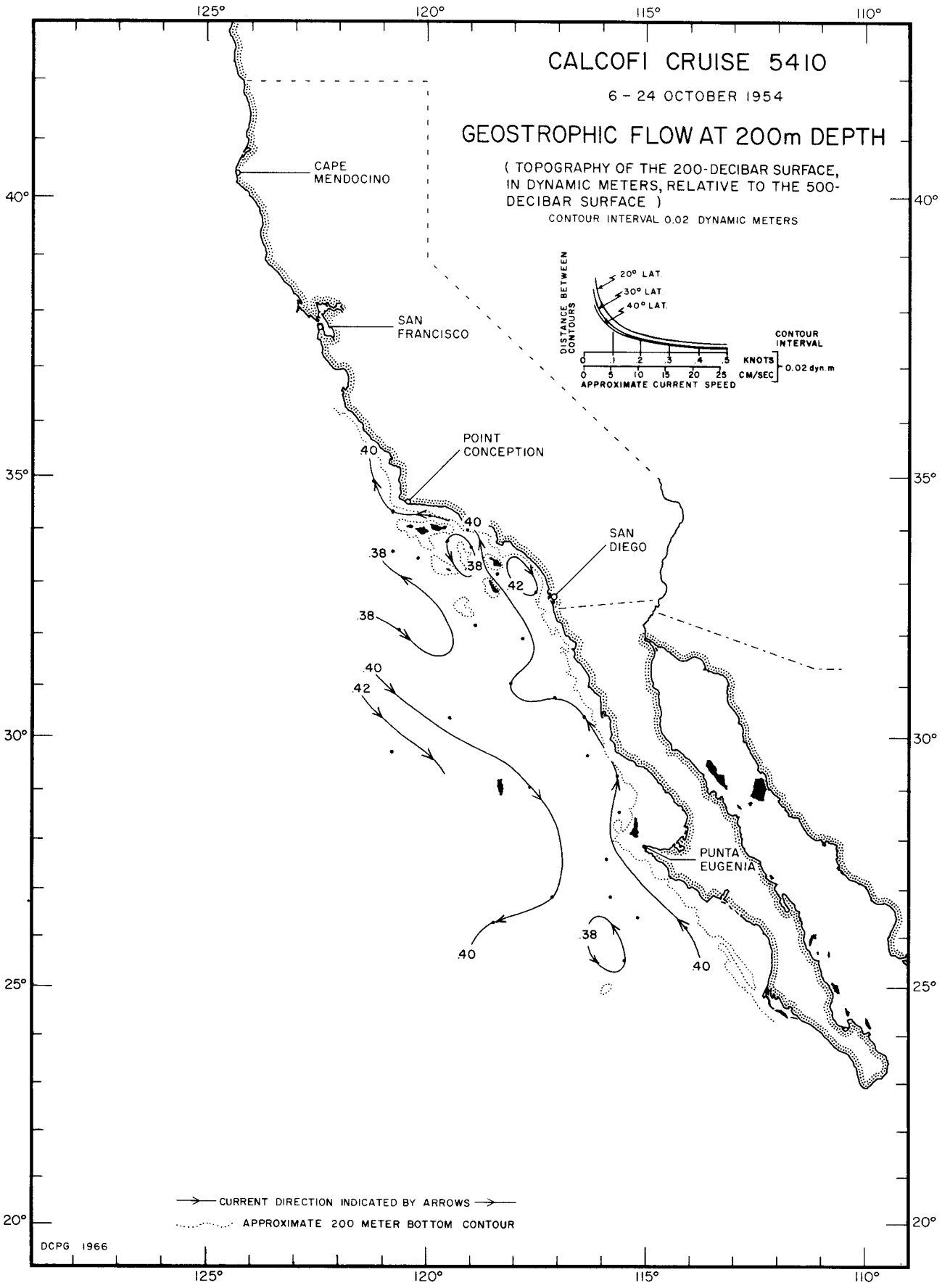
200/500 db  
5408



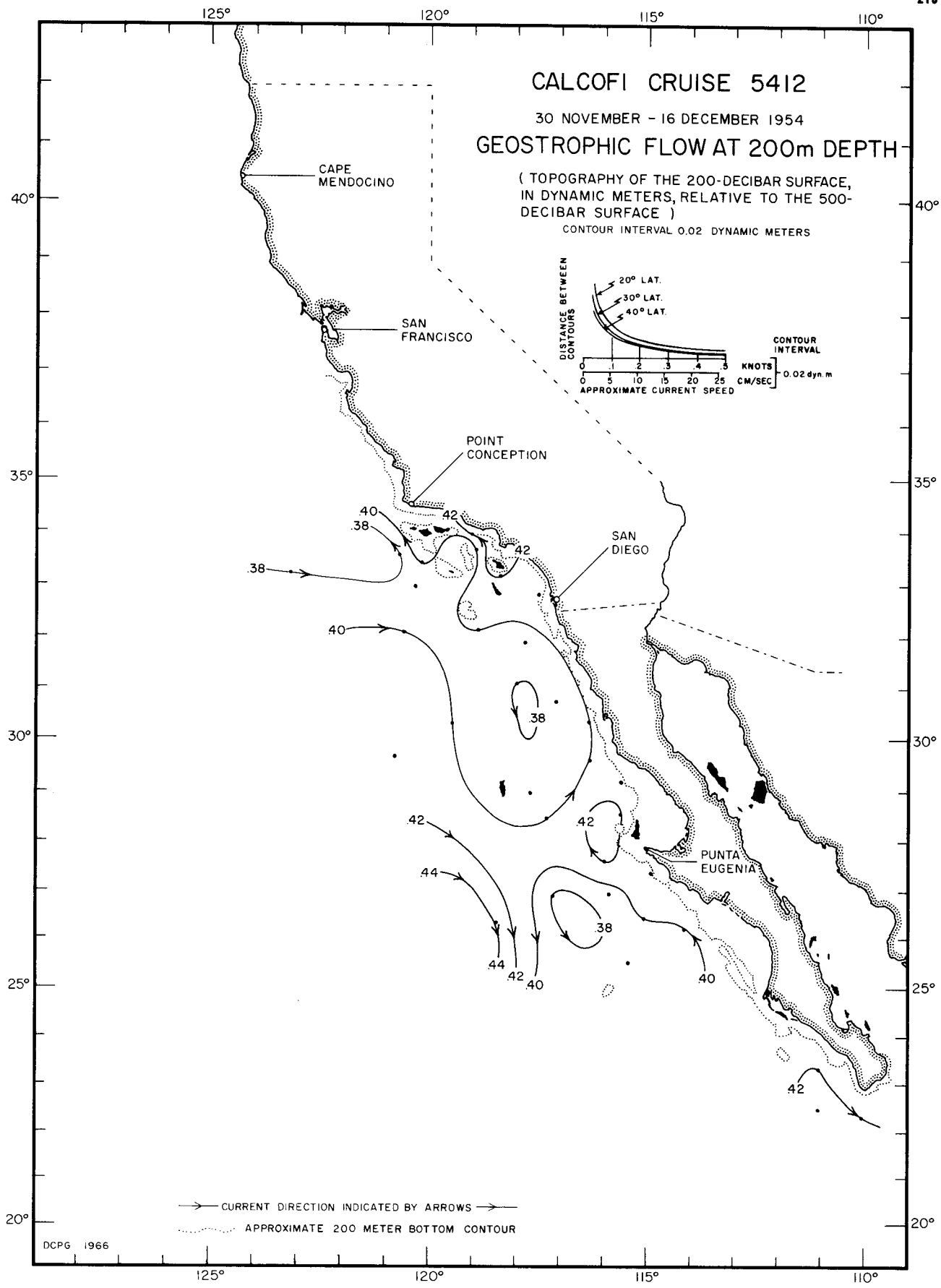


DCPG 1966

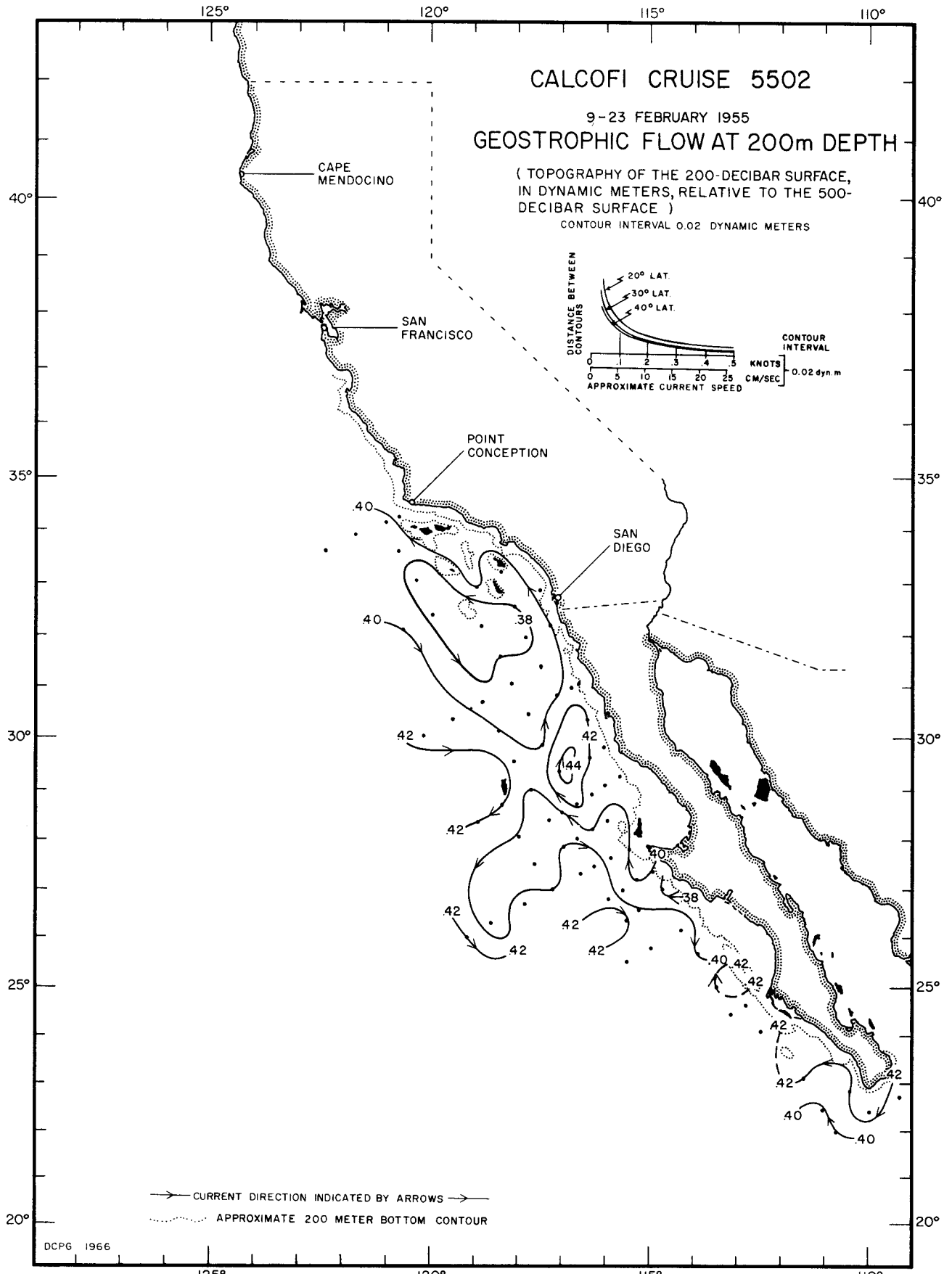
200/500 db  
5409

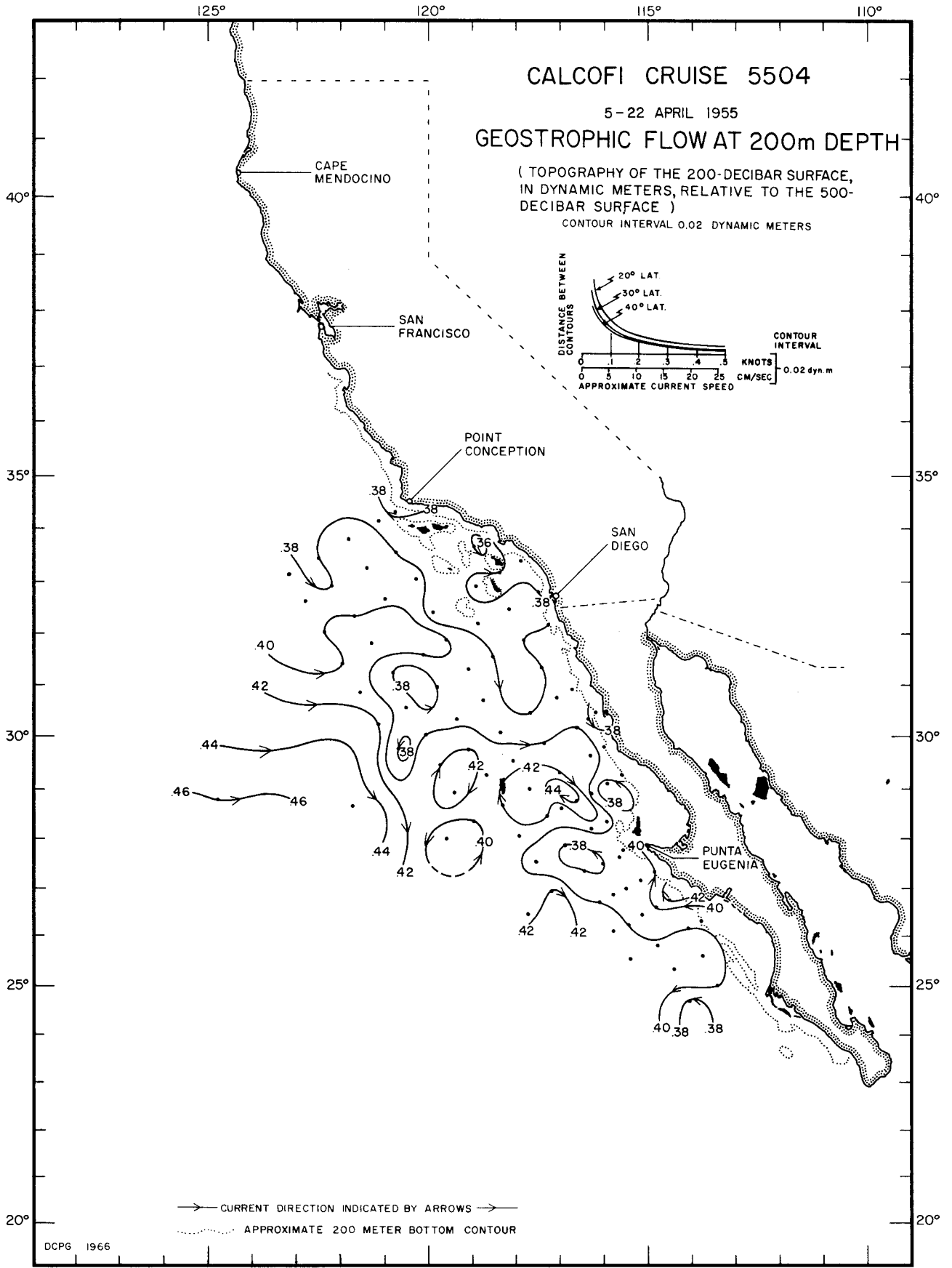


200/500 db  
5410



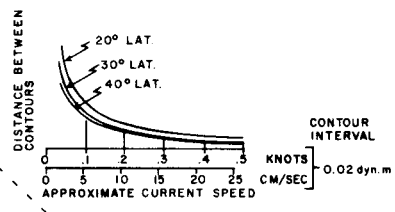
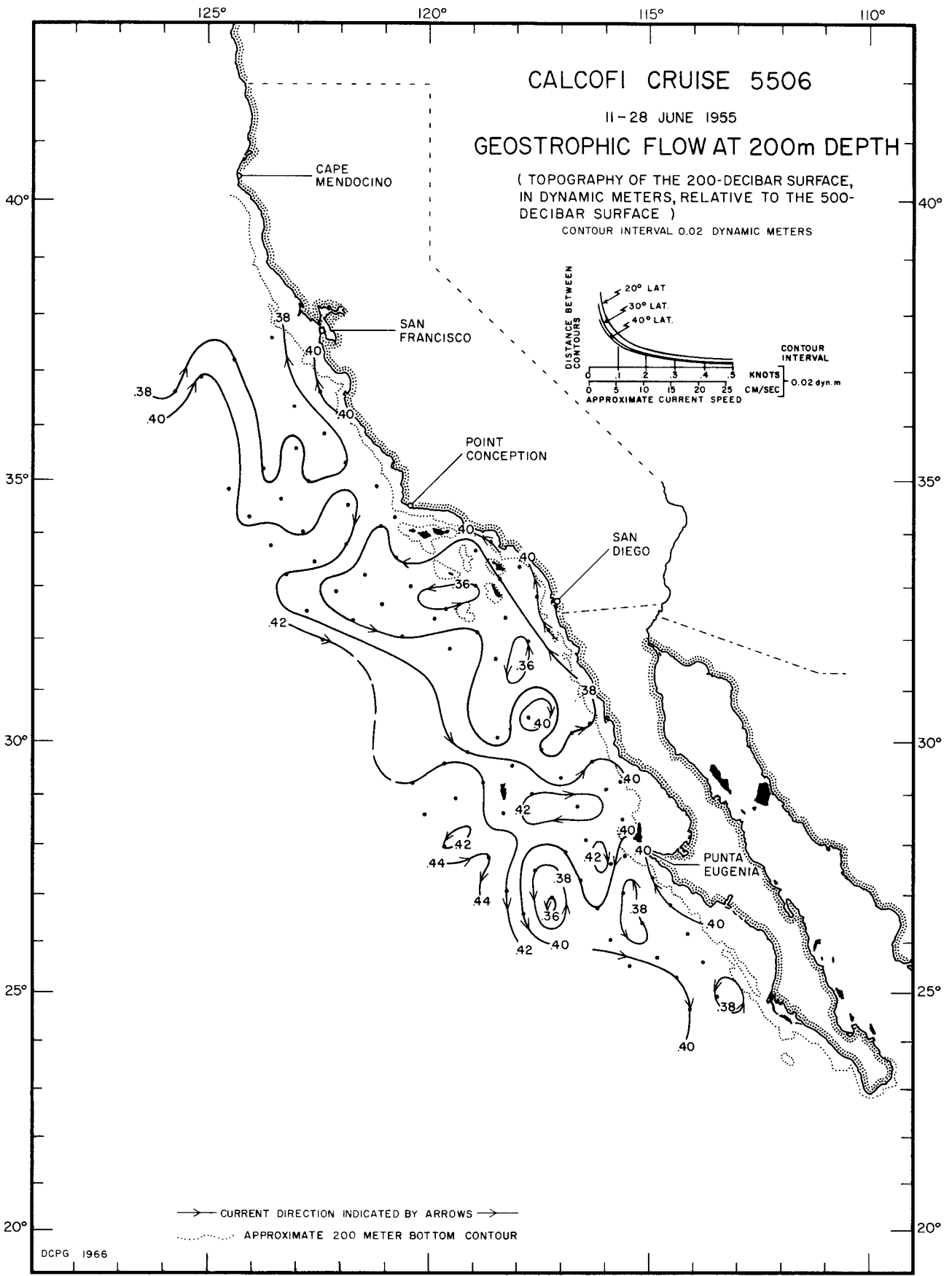
200/500 db  
5412



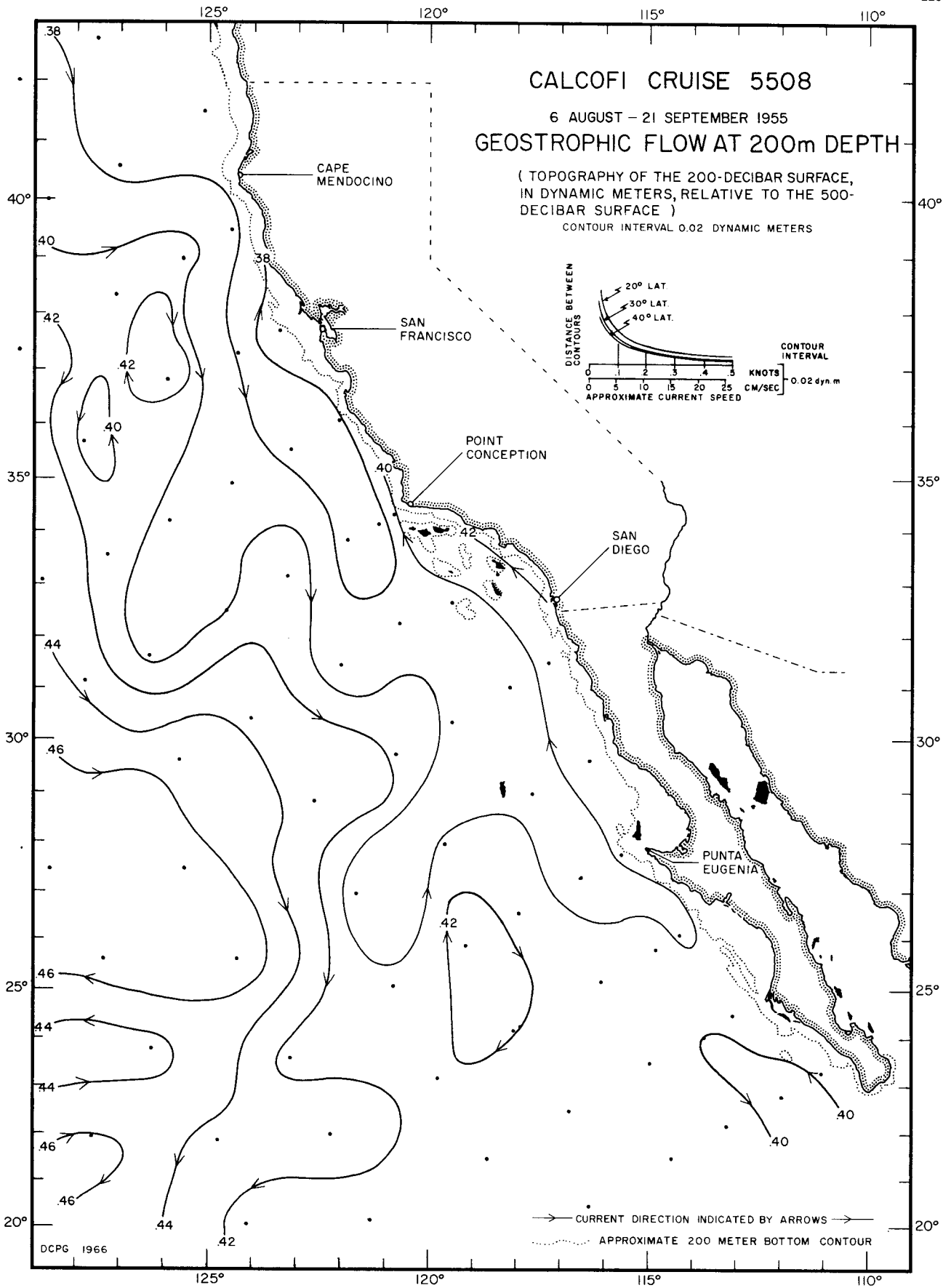


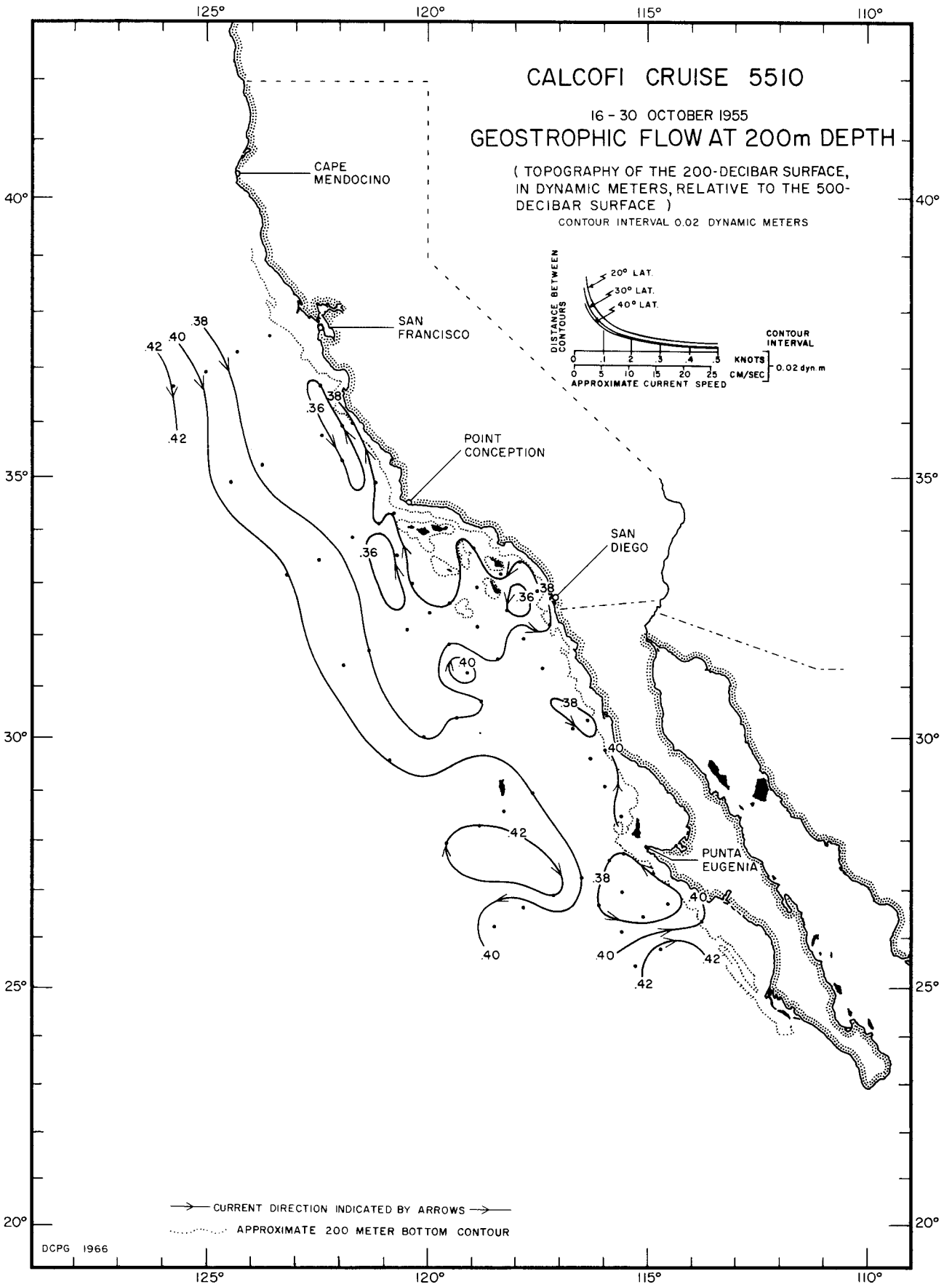
DCPG 1966

200/500 db  
5504



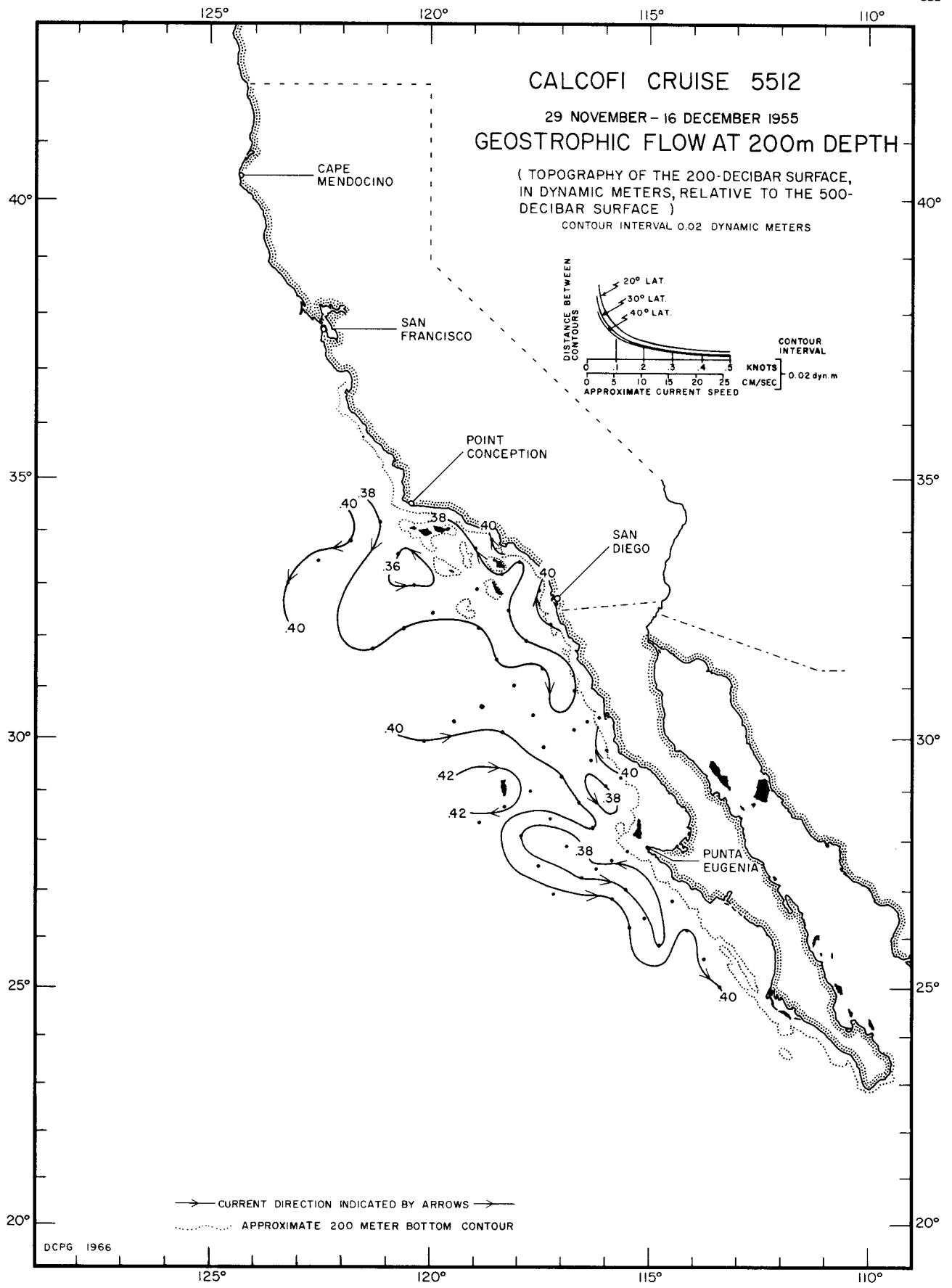
200/500 db  
5506



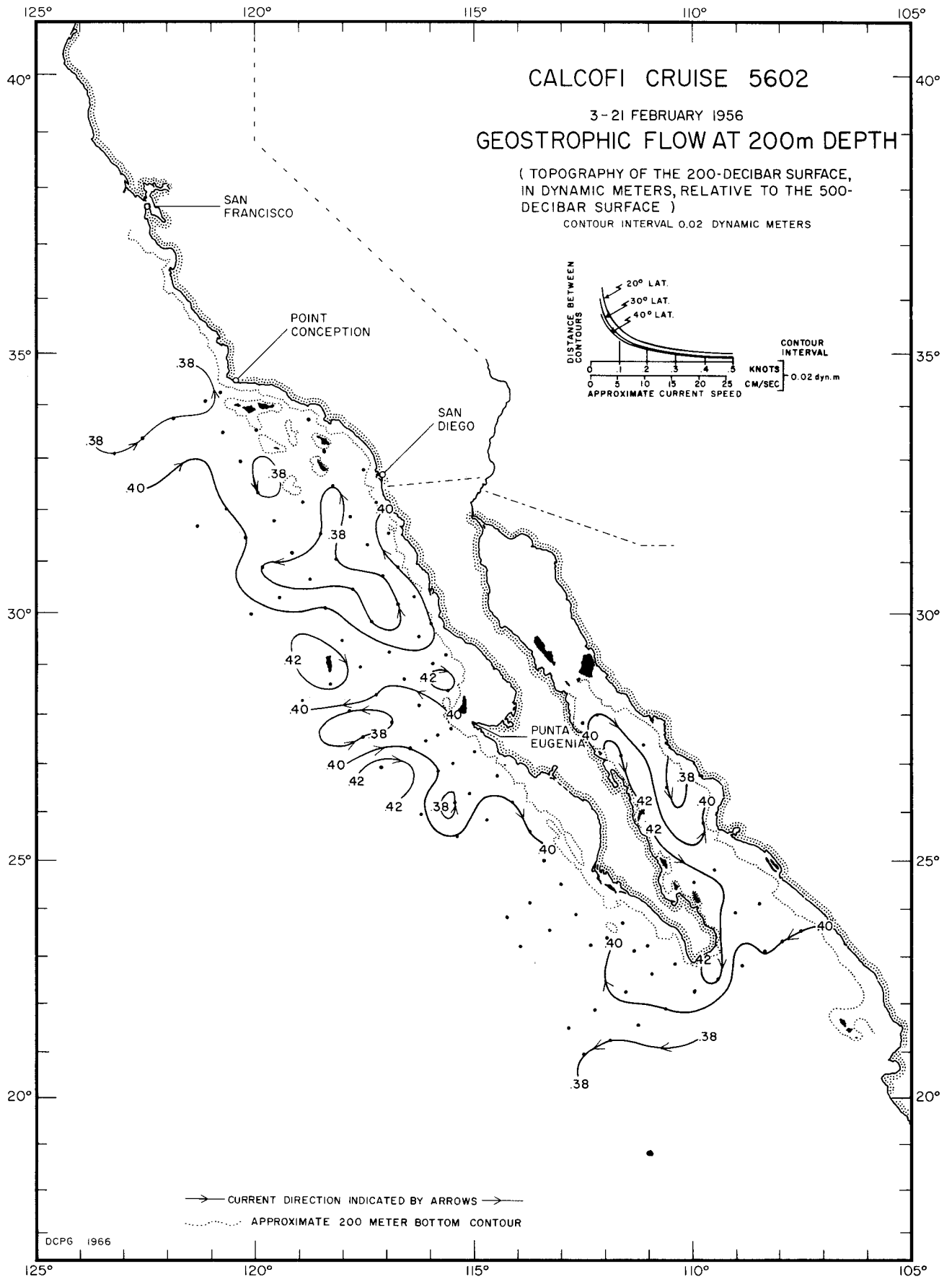


200/500 db  
5510

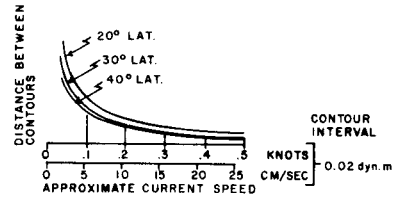
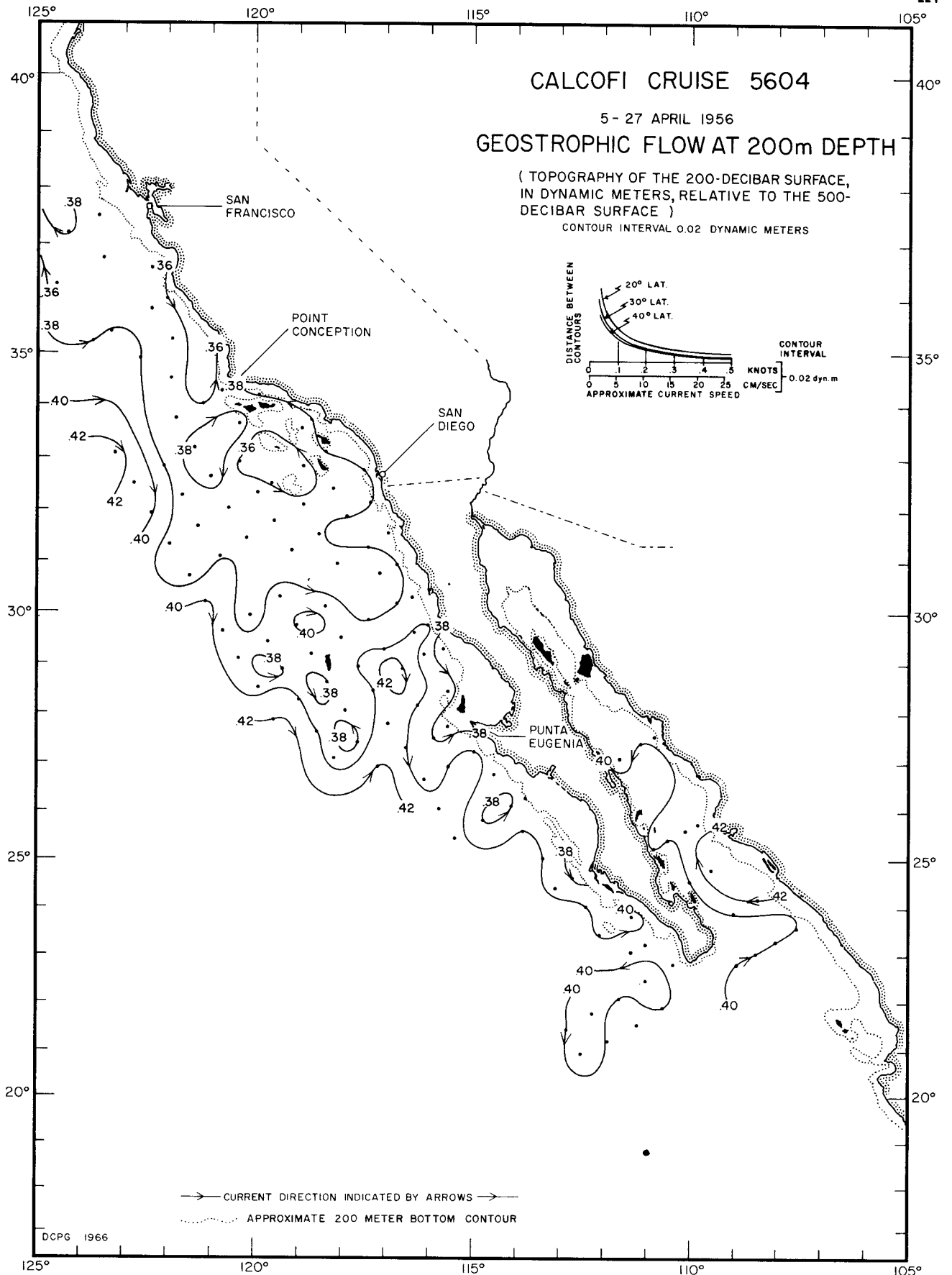




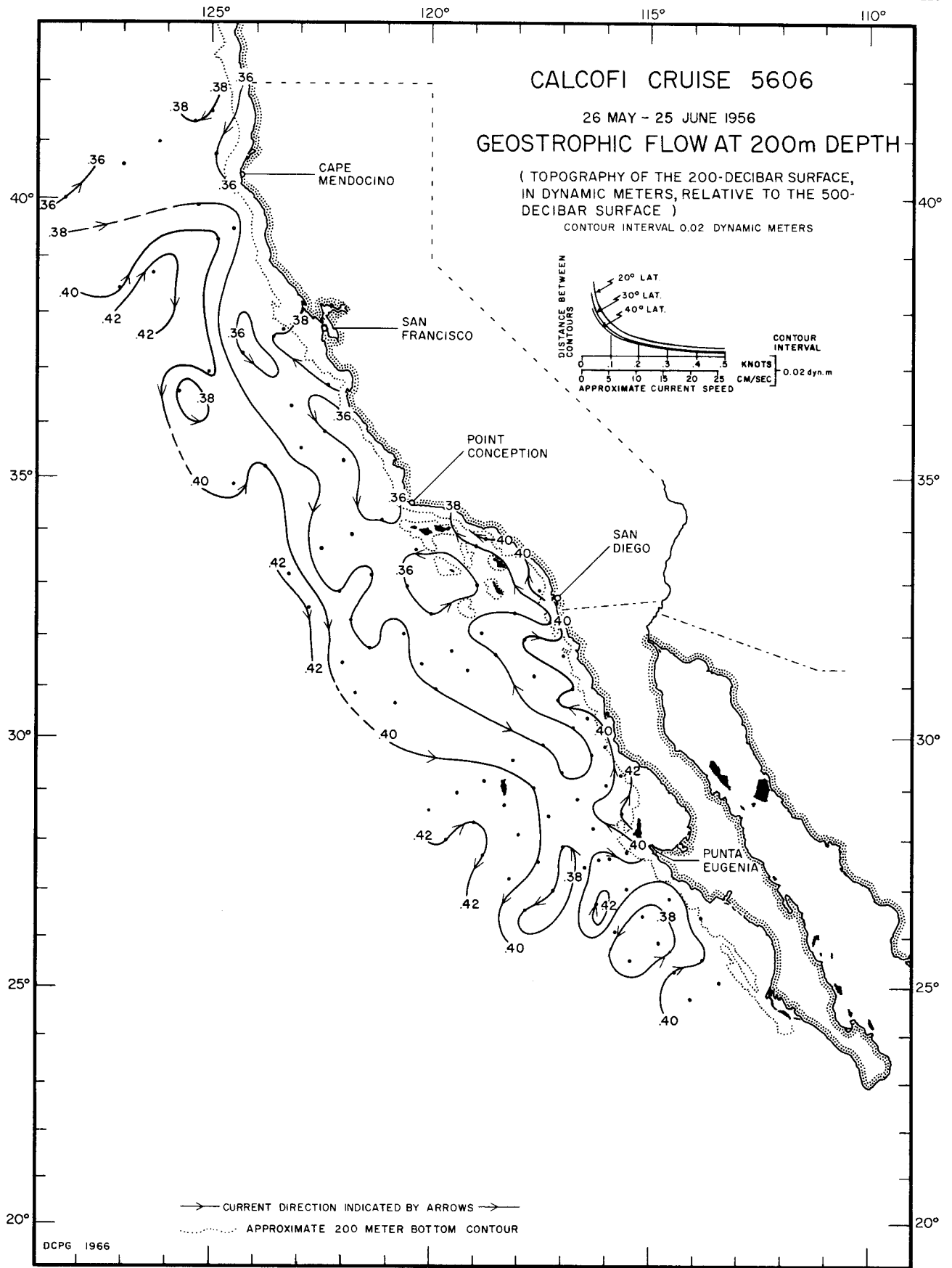
200/500 db  
5512



200/500 db  
5602

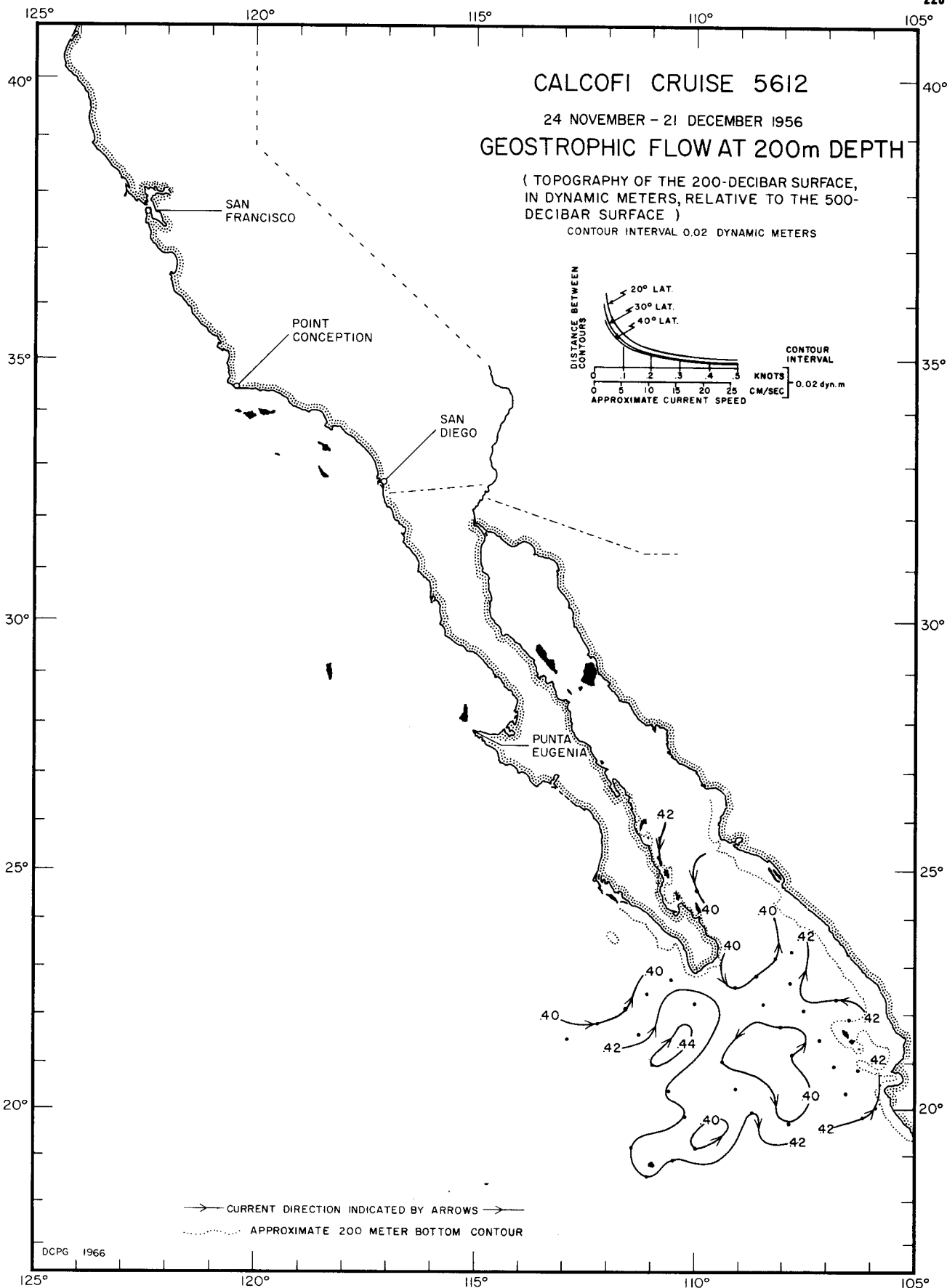


200/500 db  
 5604

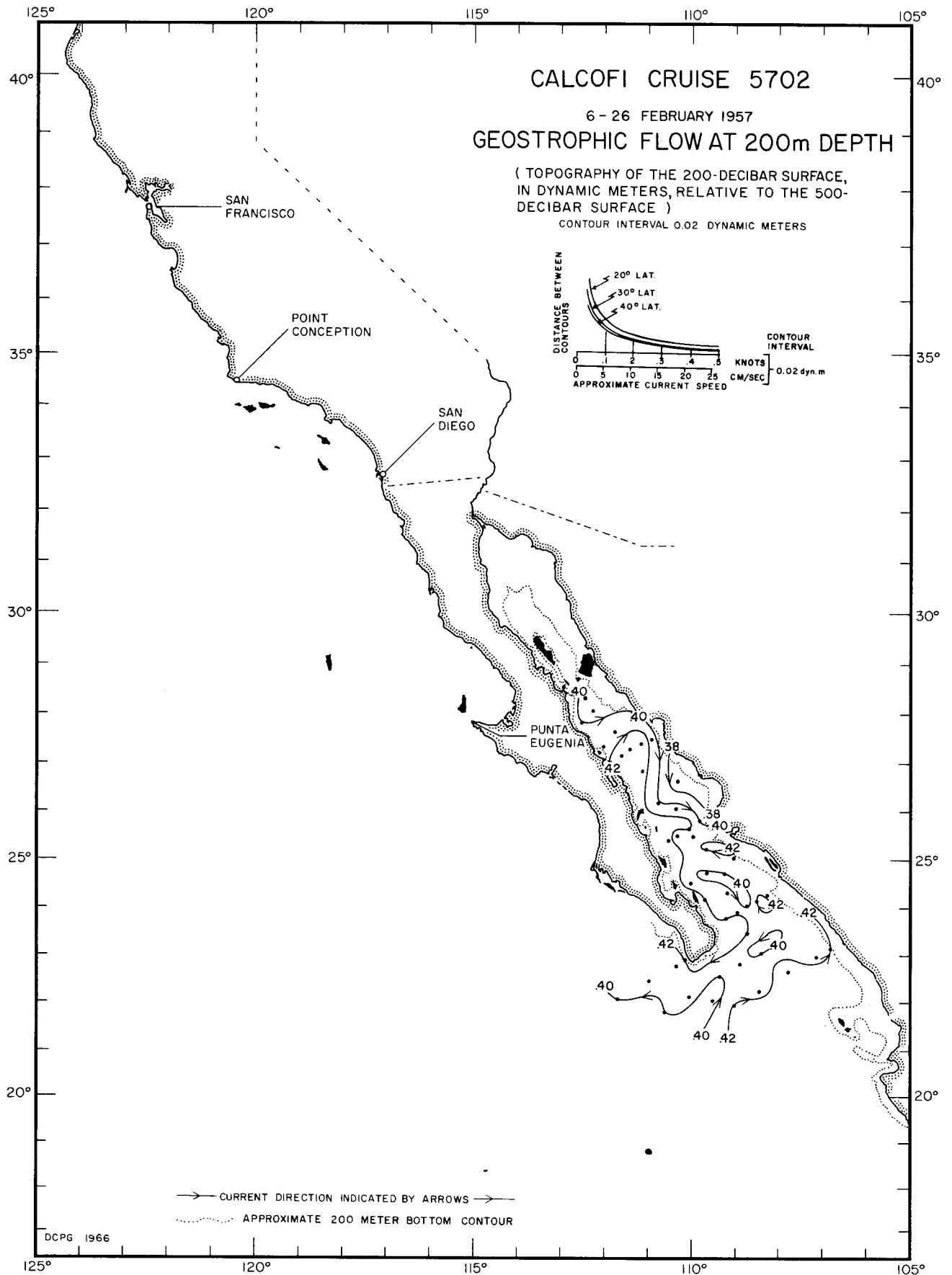


DCPG 1966

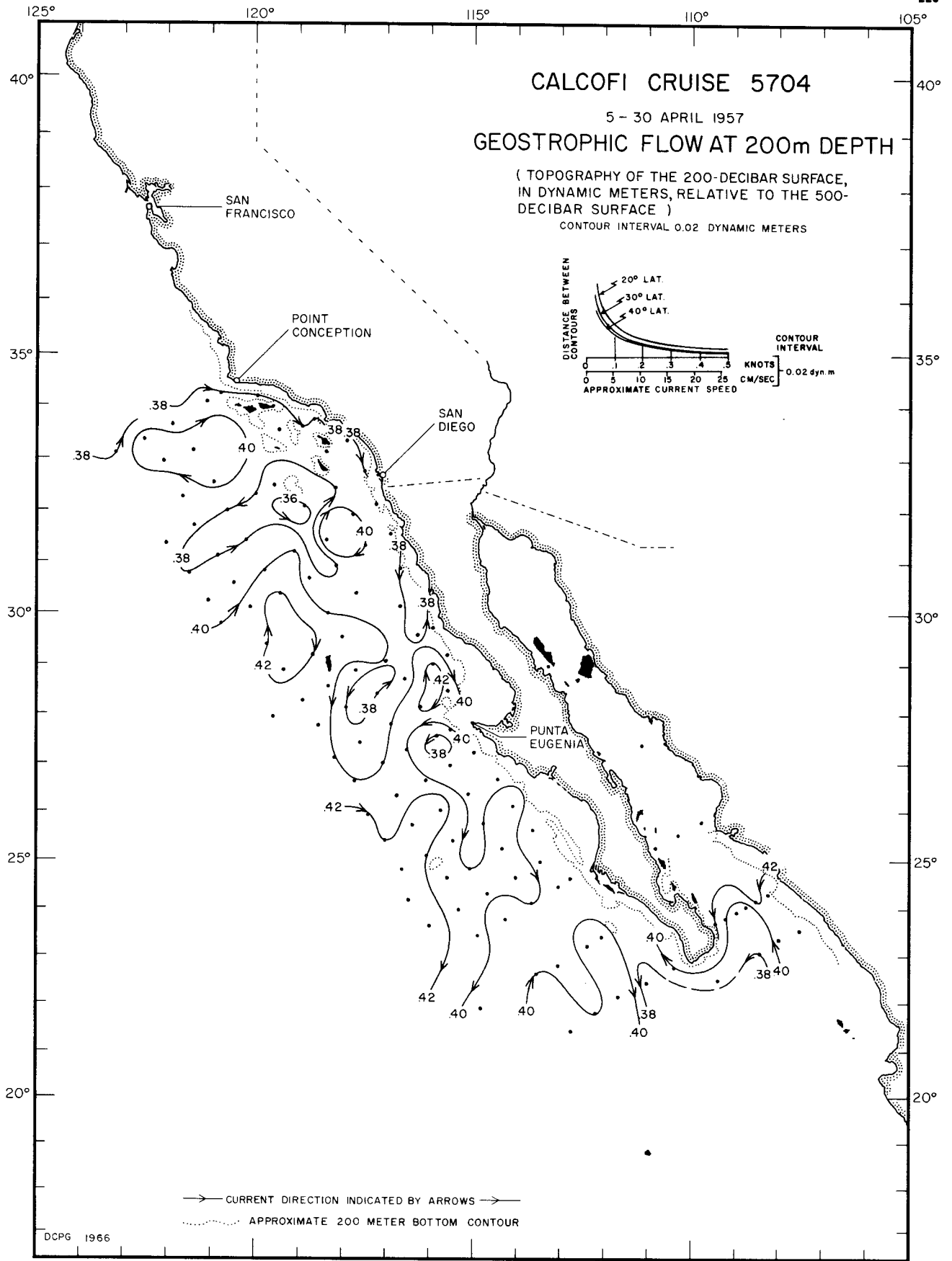
200/500 db  
5606



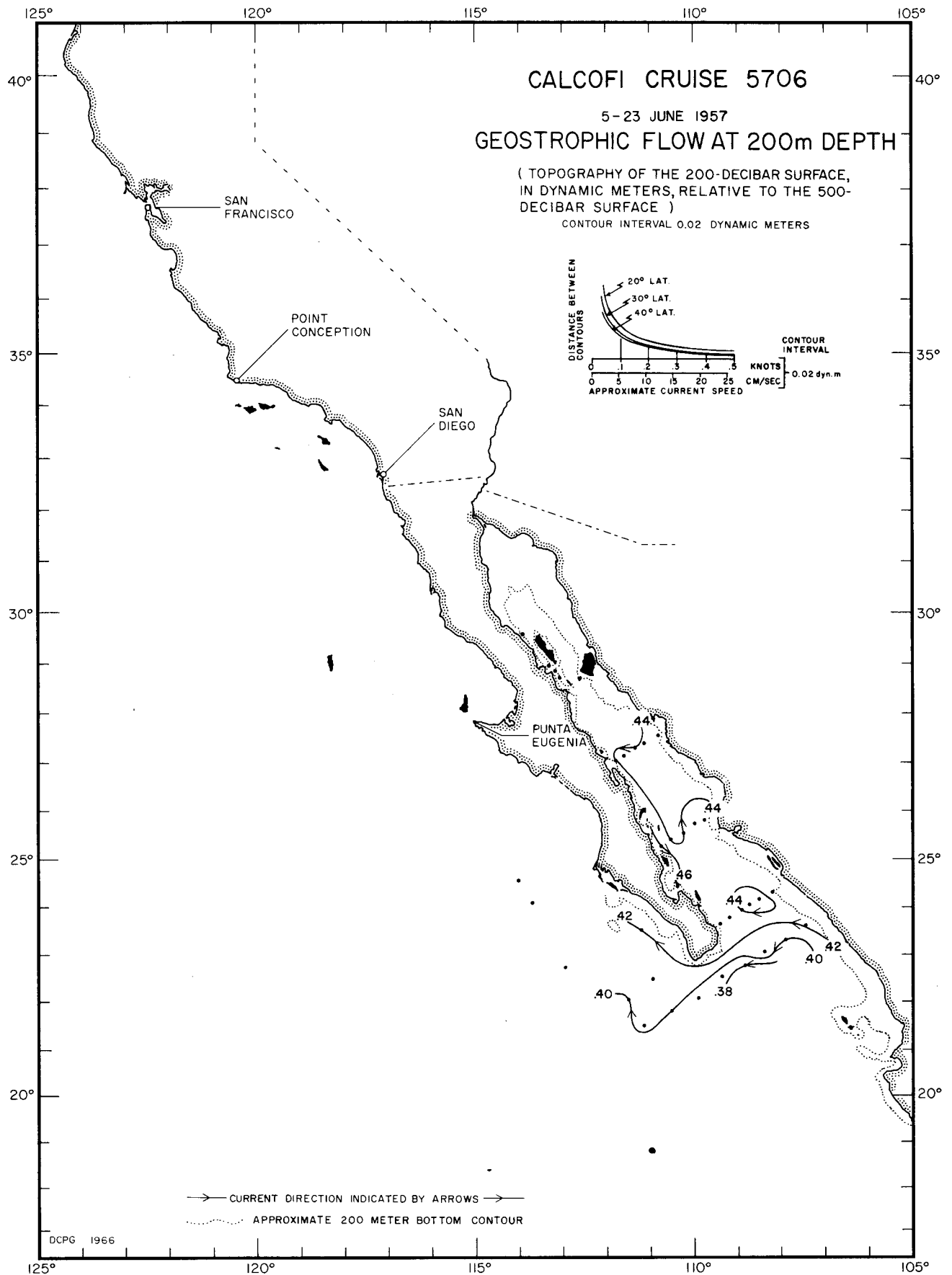
200/500 db  
5612



200/500 db  
5702



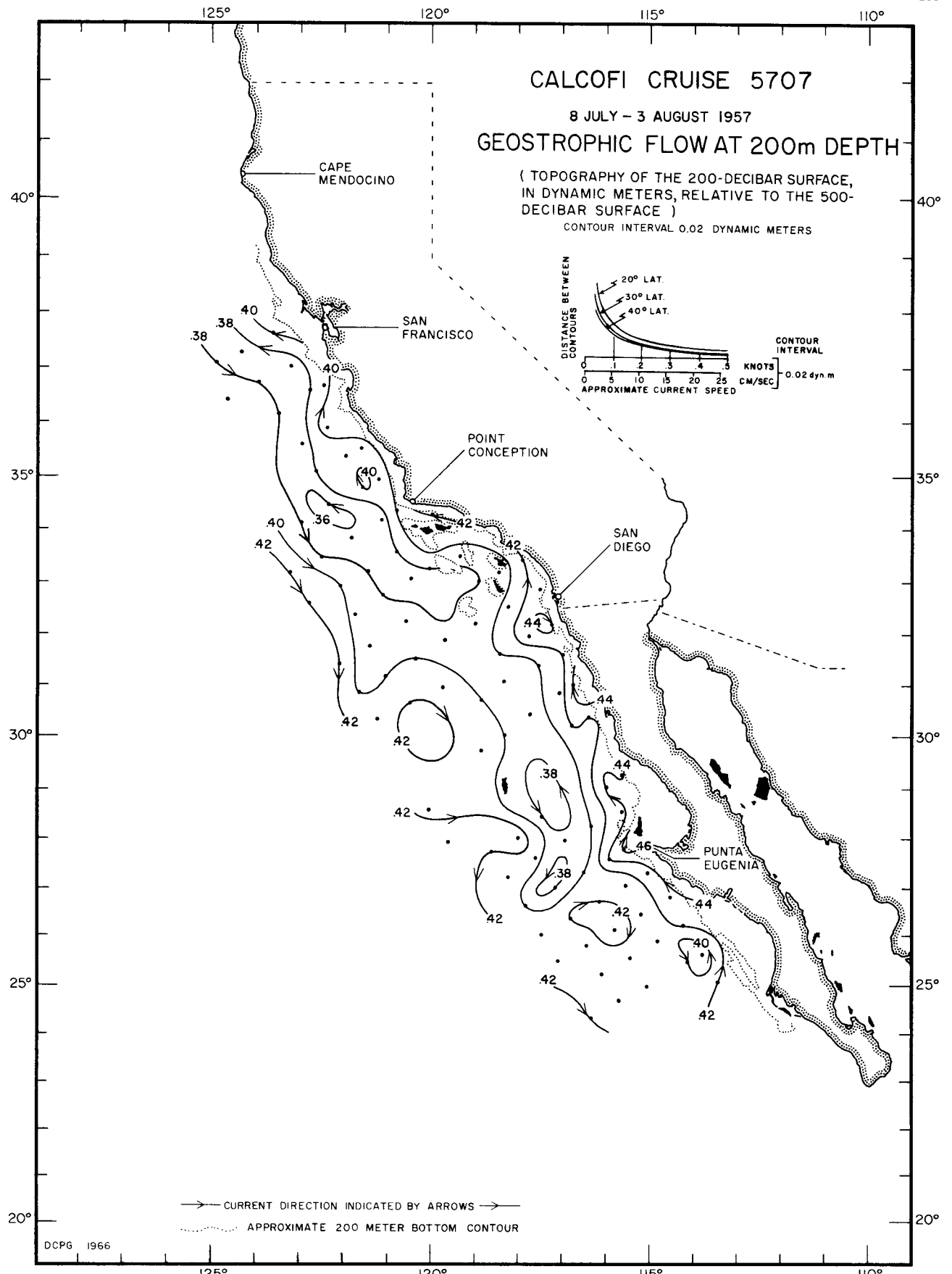
200/500 db  
 5704



DCPG 1966

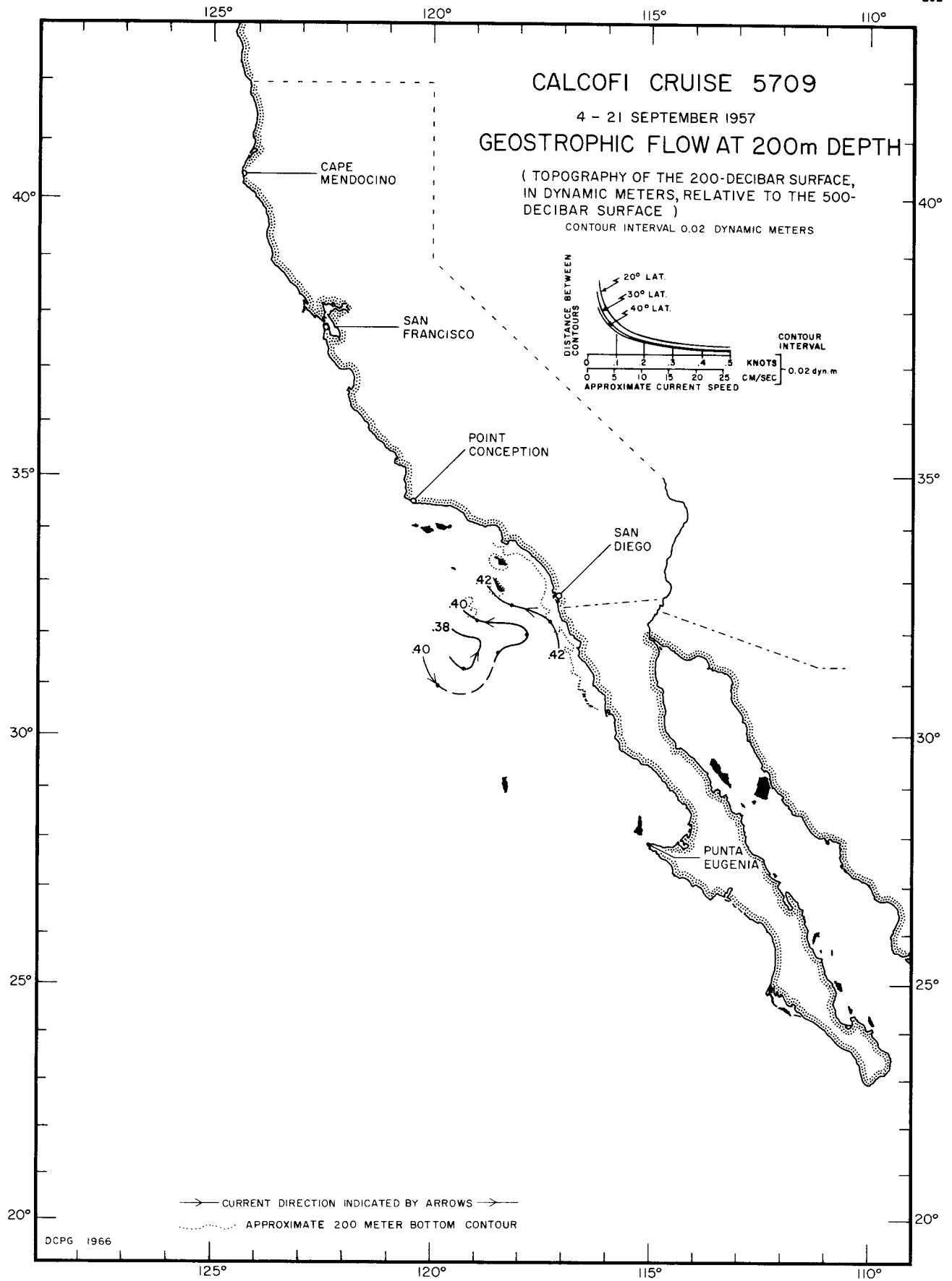
200/500 db  
5706



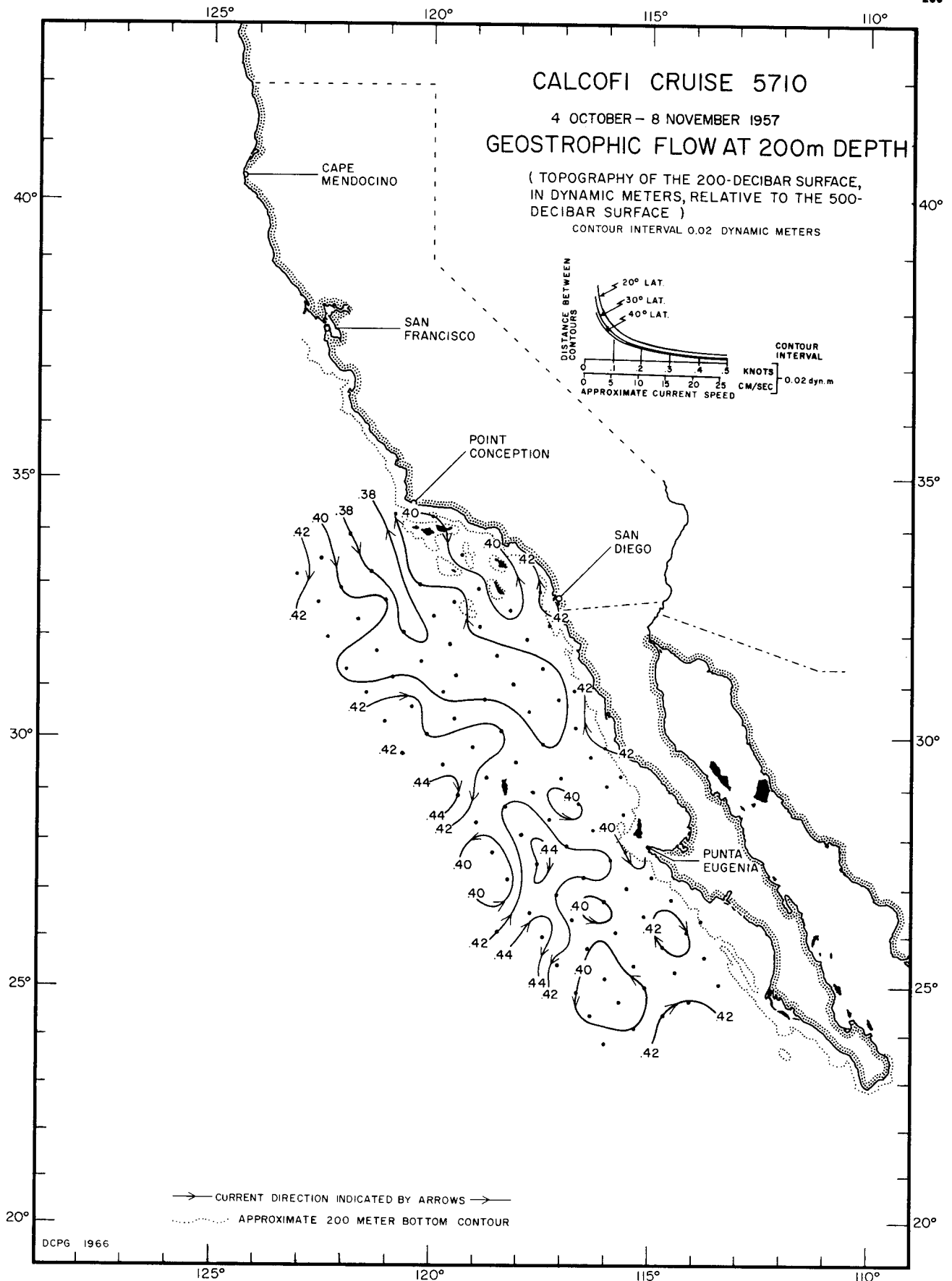


200/500 db  
5707

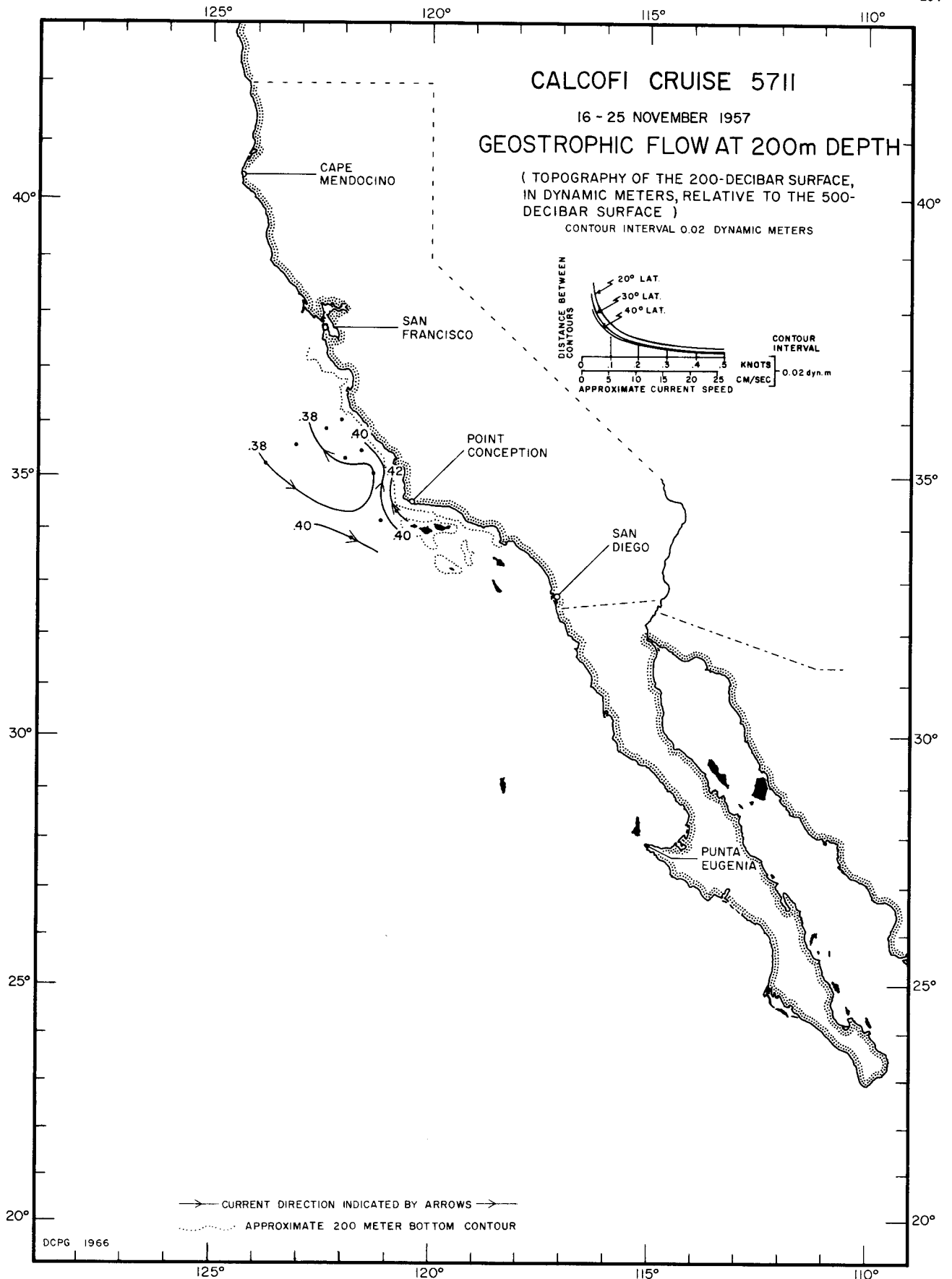




200/500 db  
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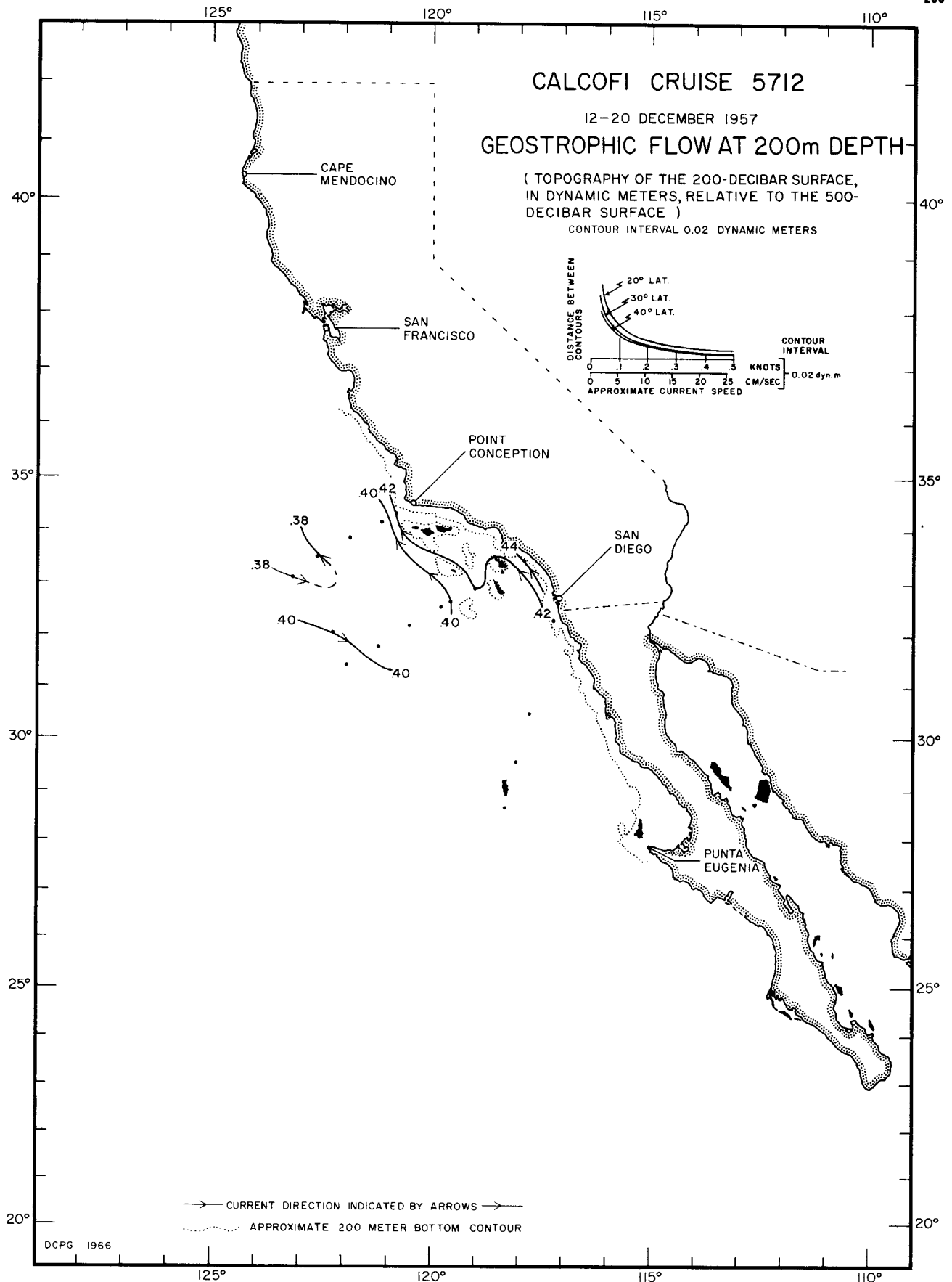


200/500 db  
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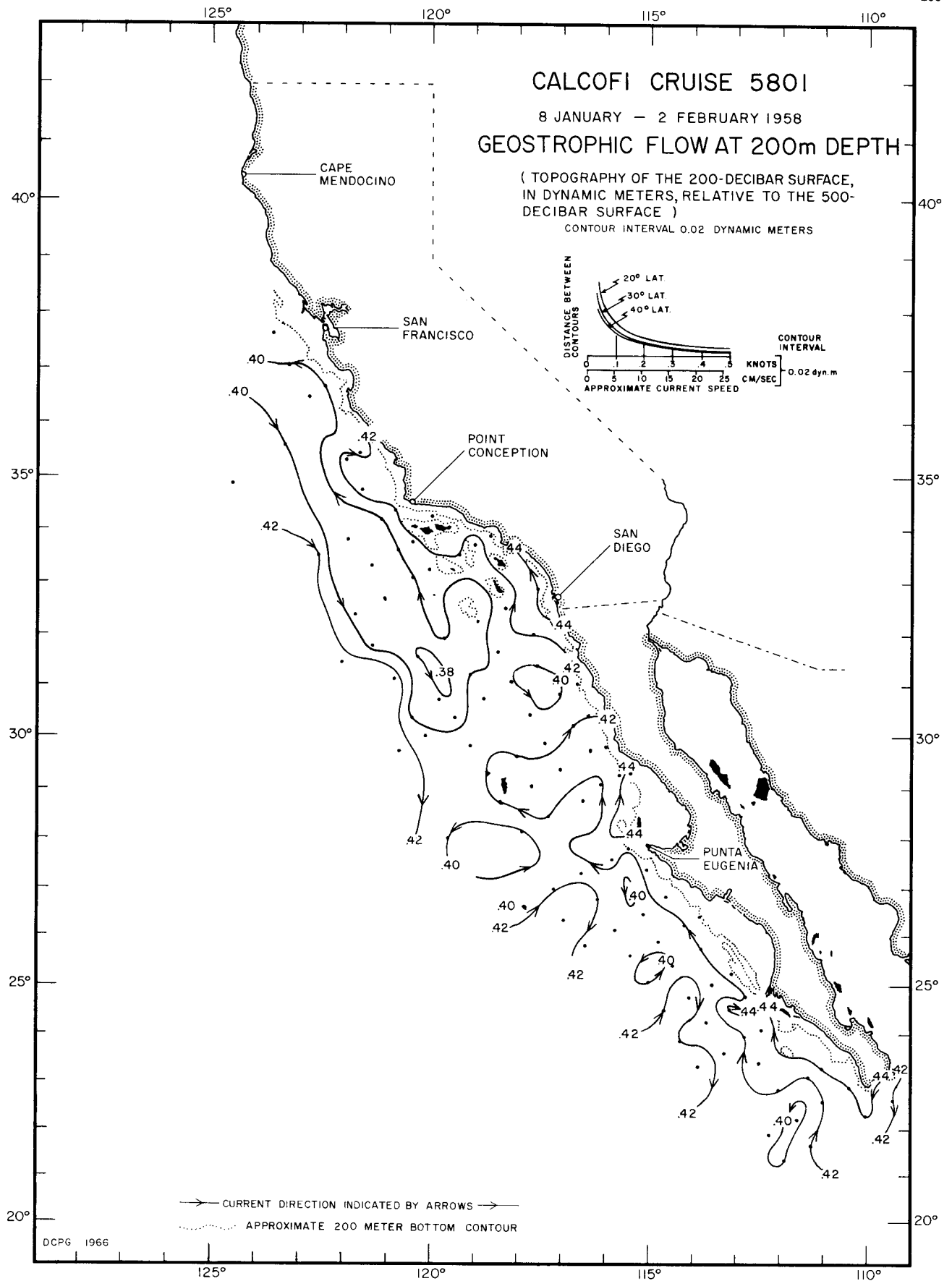


DCPG 1966

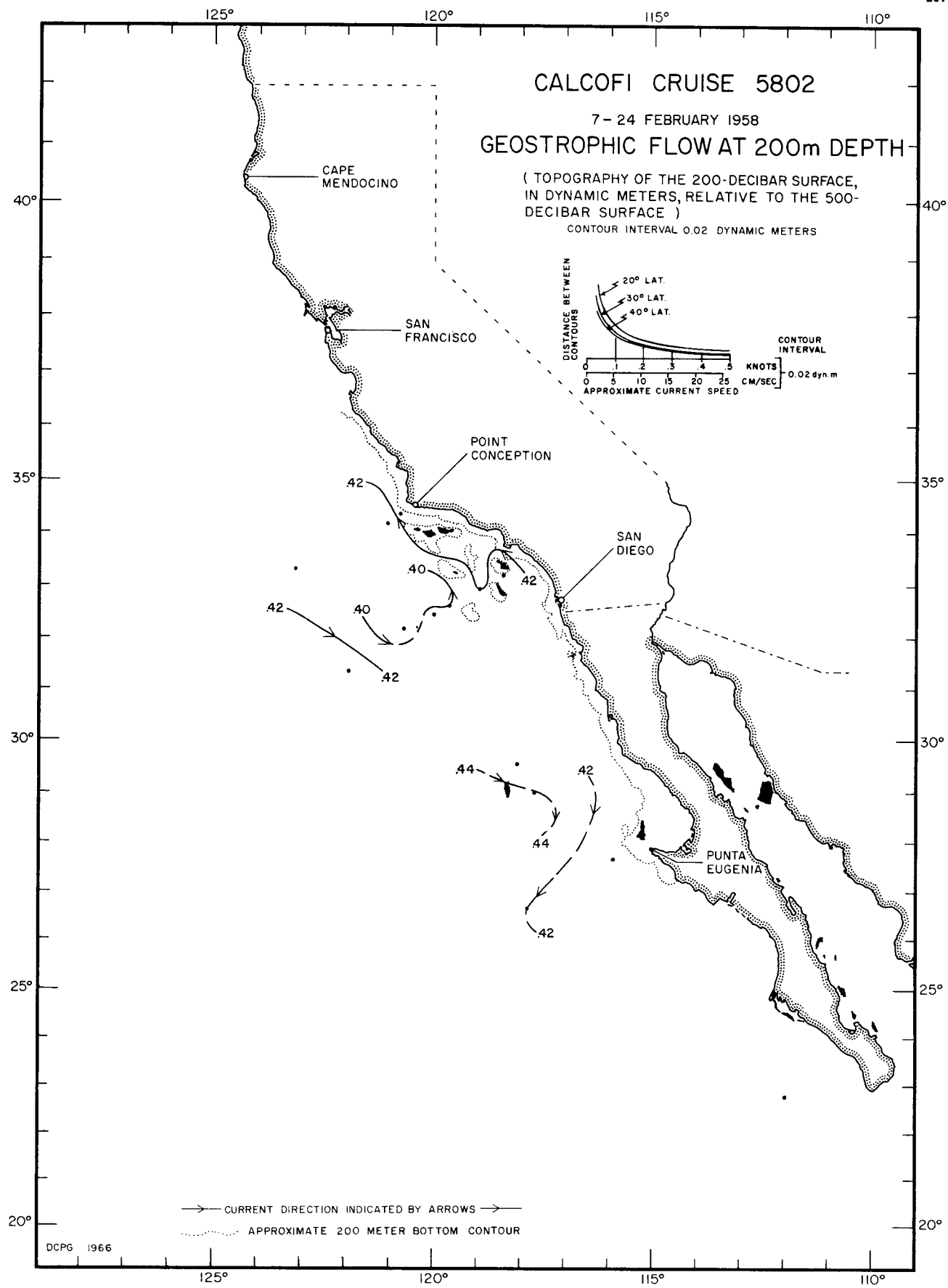
200/500 db  
5711



200/500 db  
5712

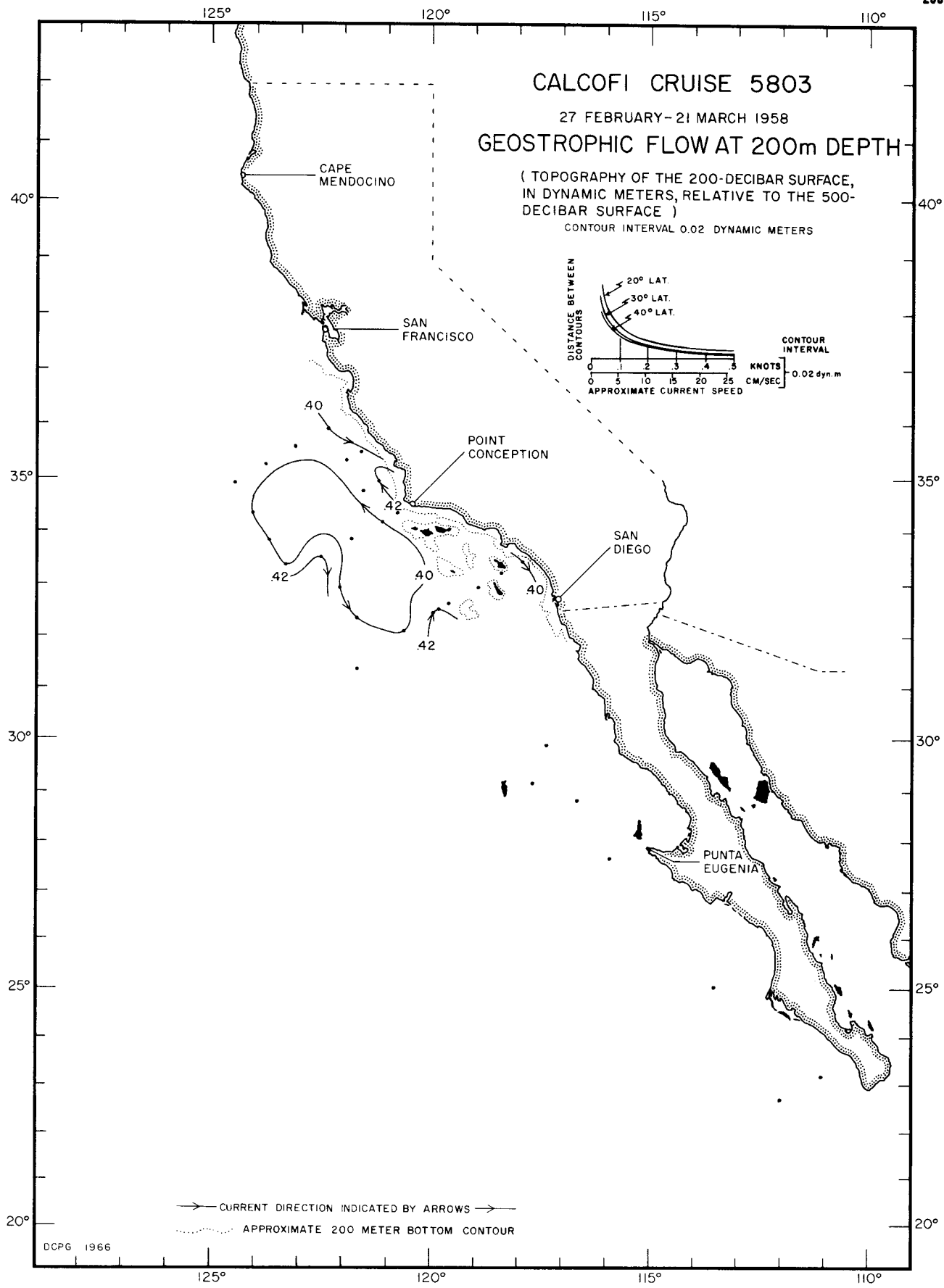


200/500 db  
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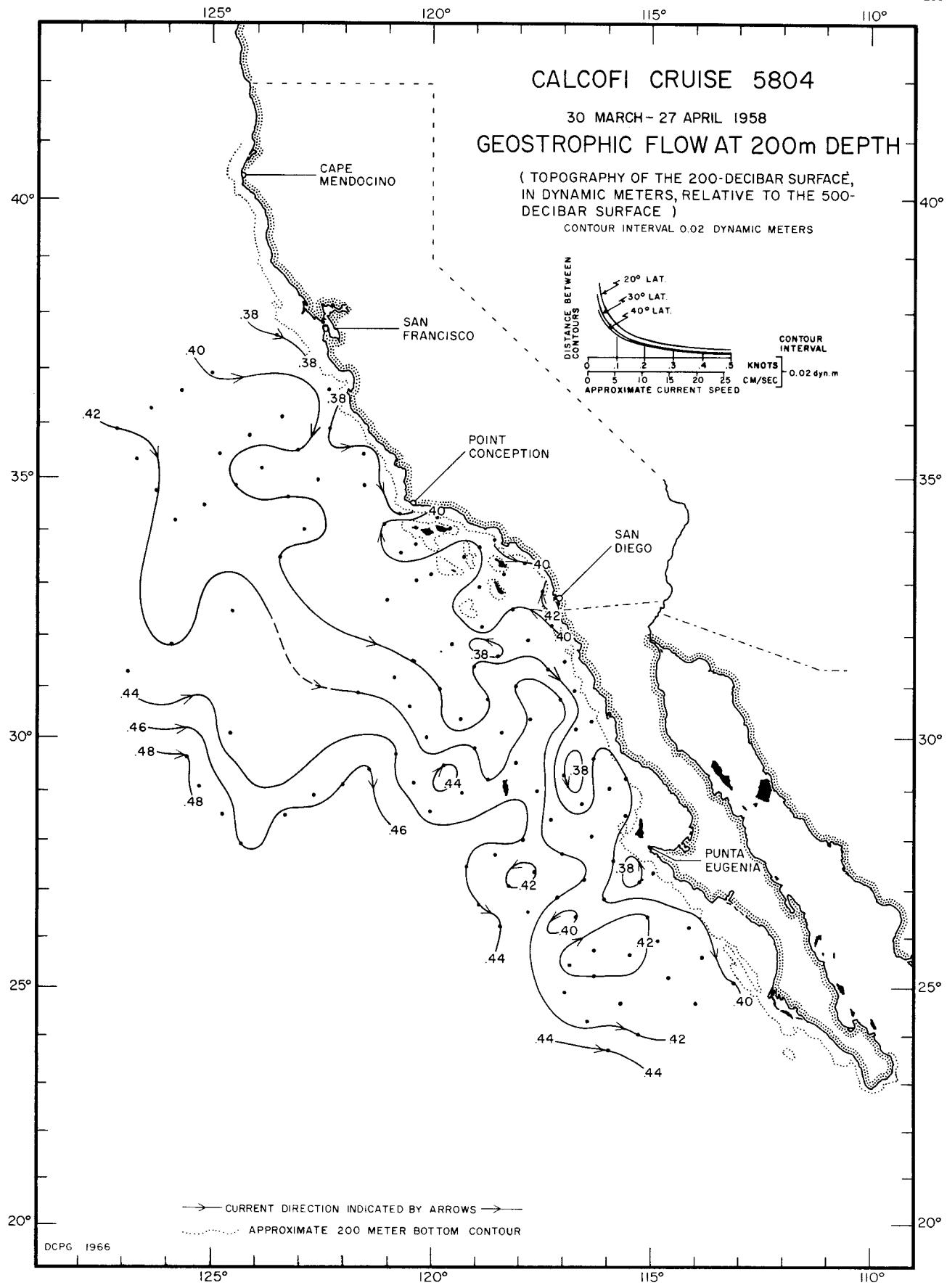


200/500 db  
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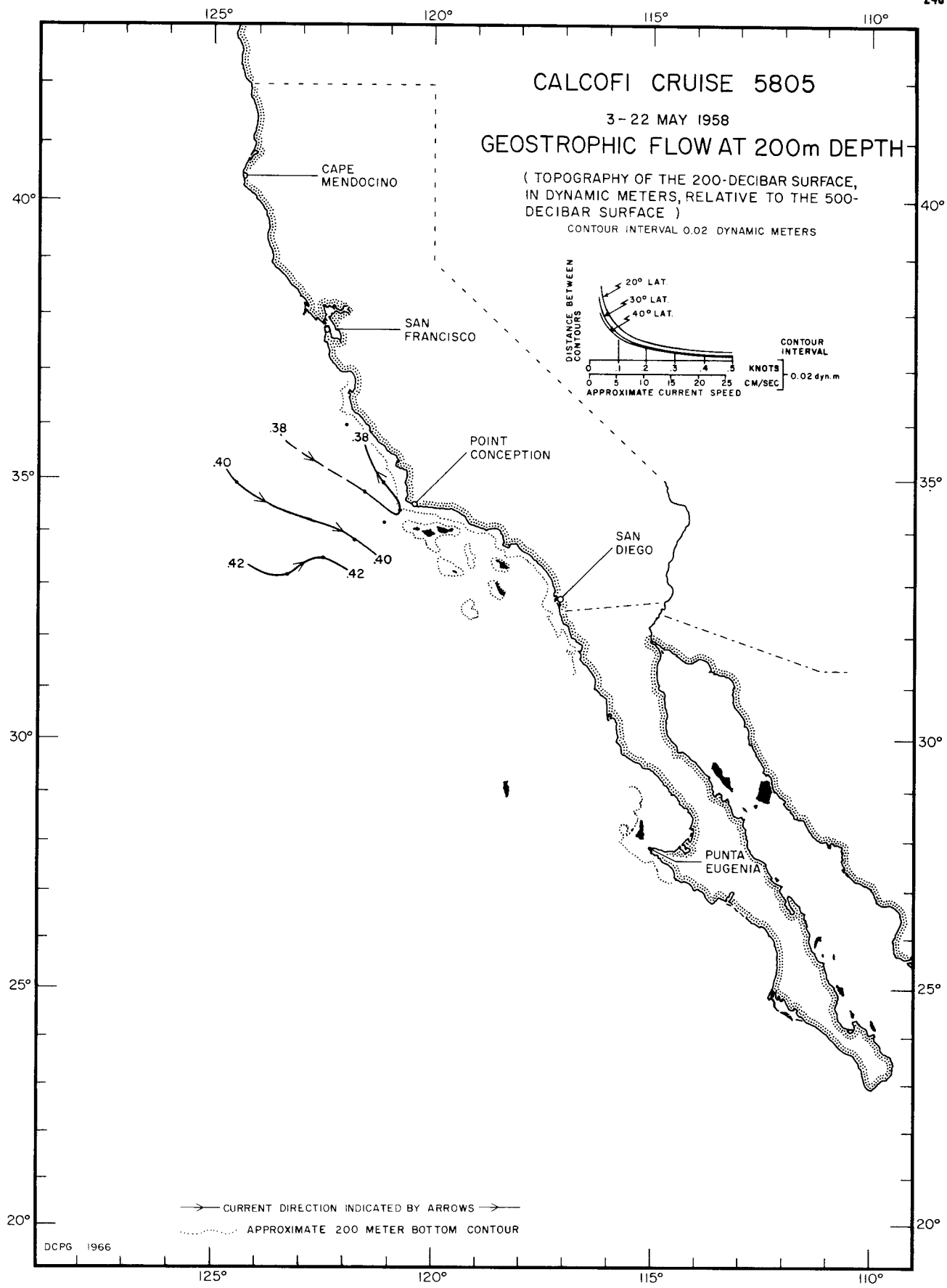




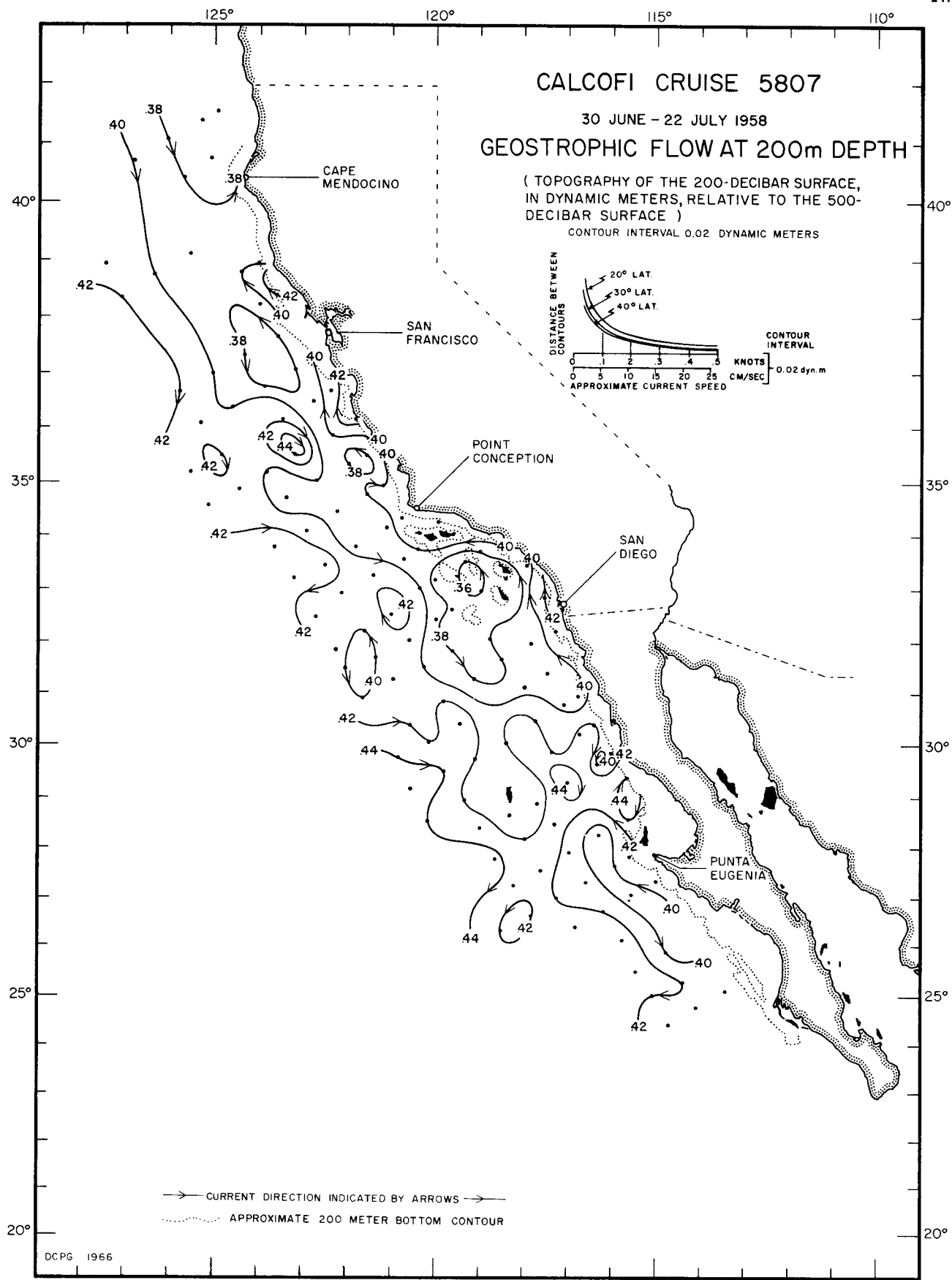
200/500 db  
5803



200/500 db  
5804

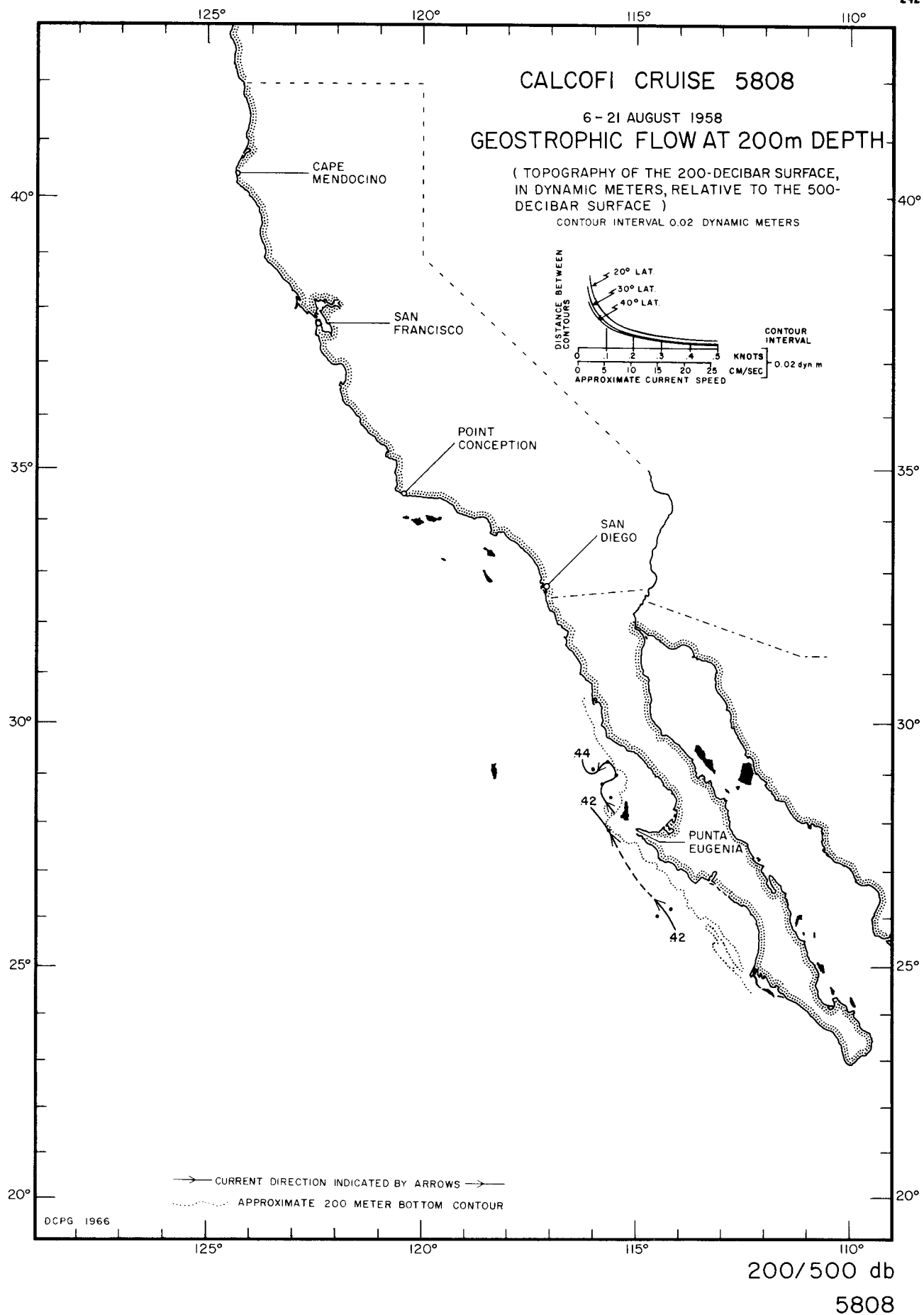


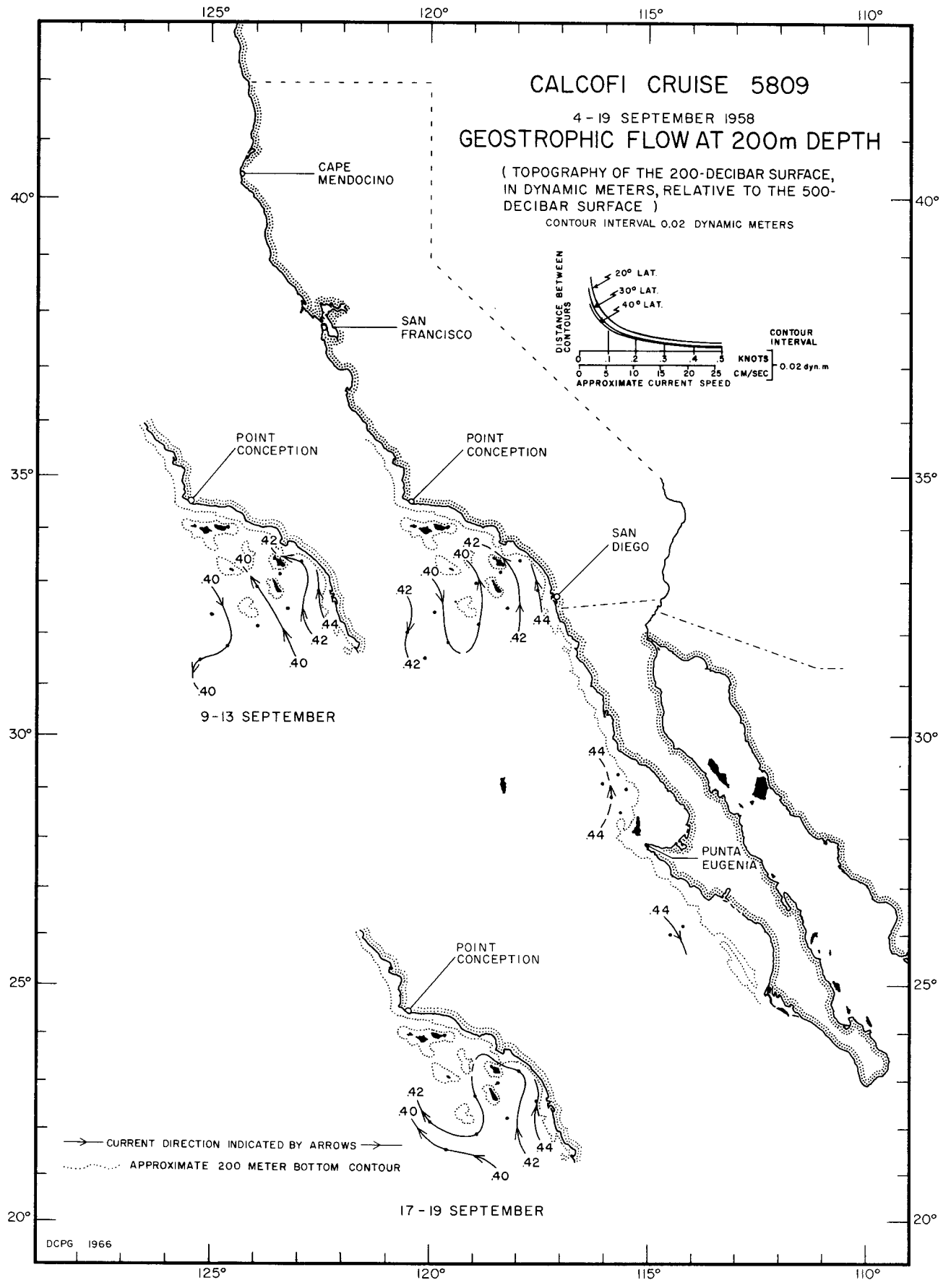
200/500 db  
5805



DCPG 1966

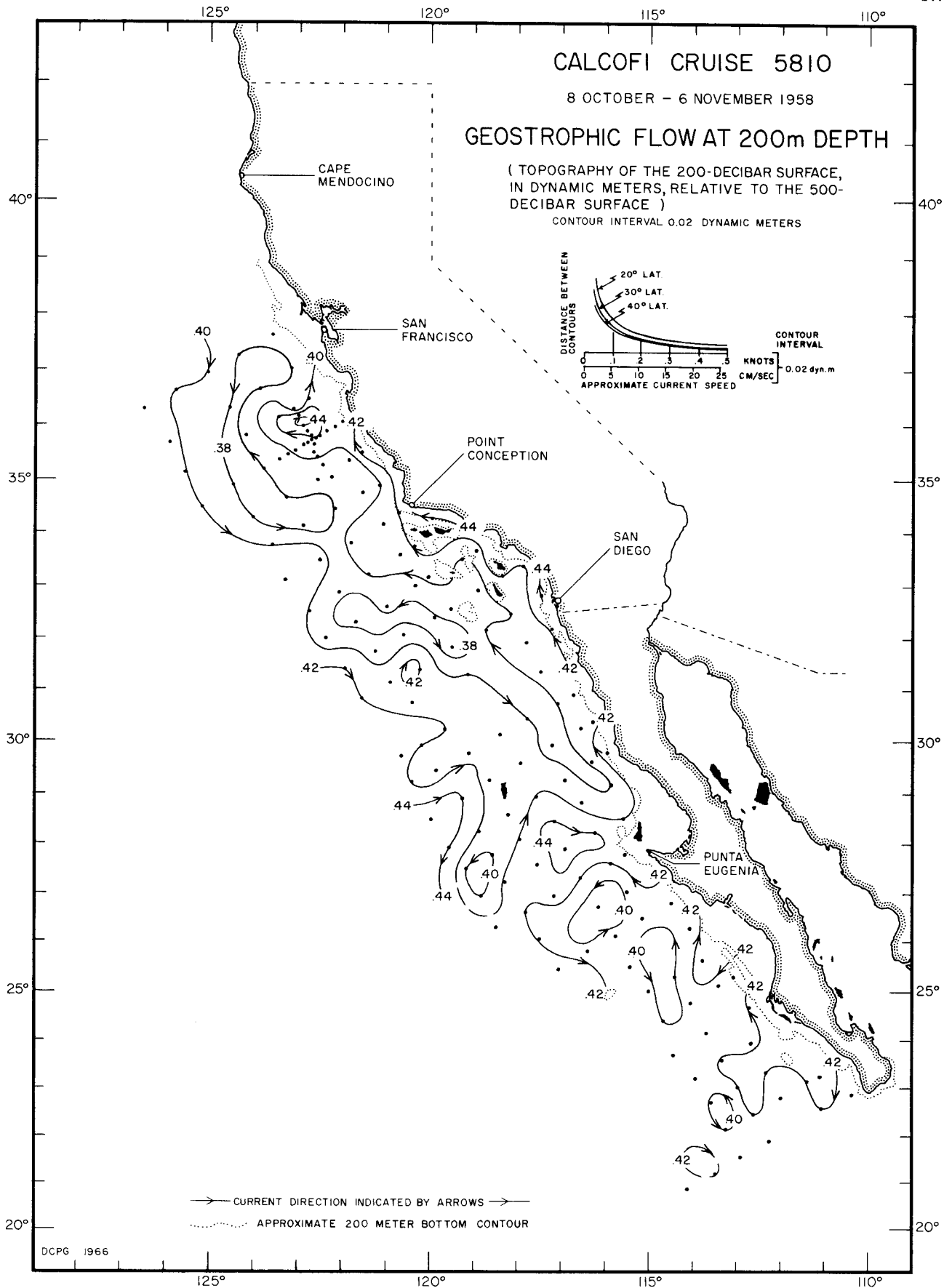
200/500 db  
5807



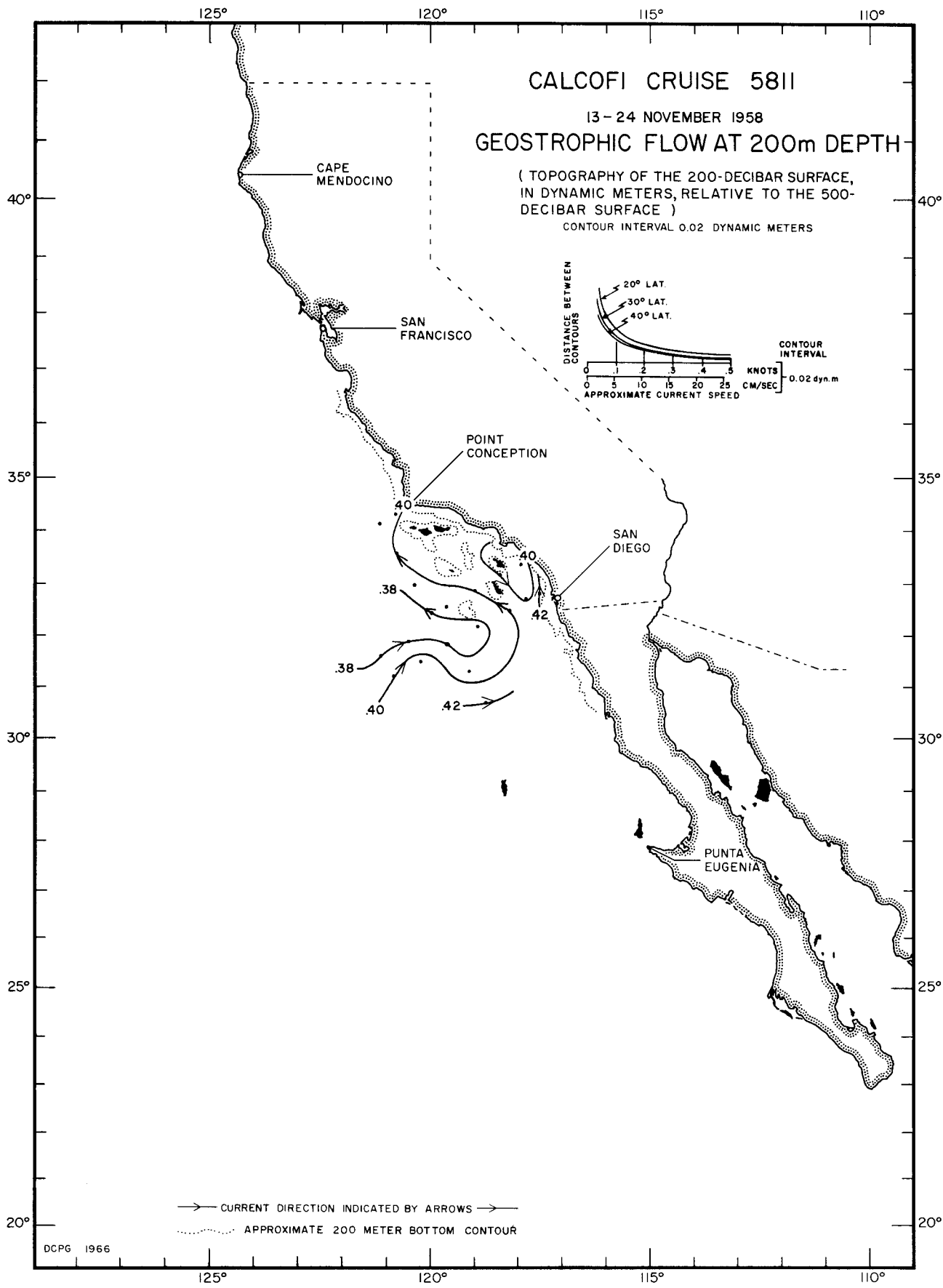


200/500 db  
5809

DCPG 1966



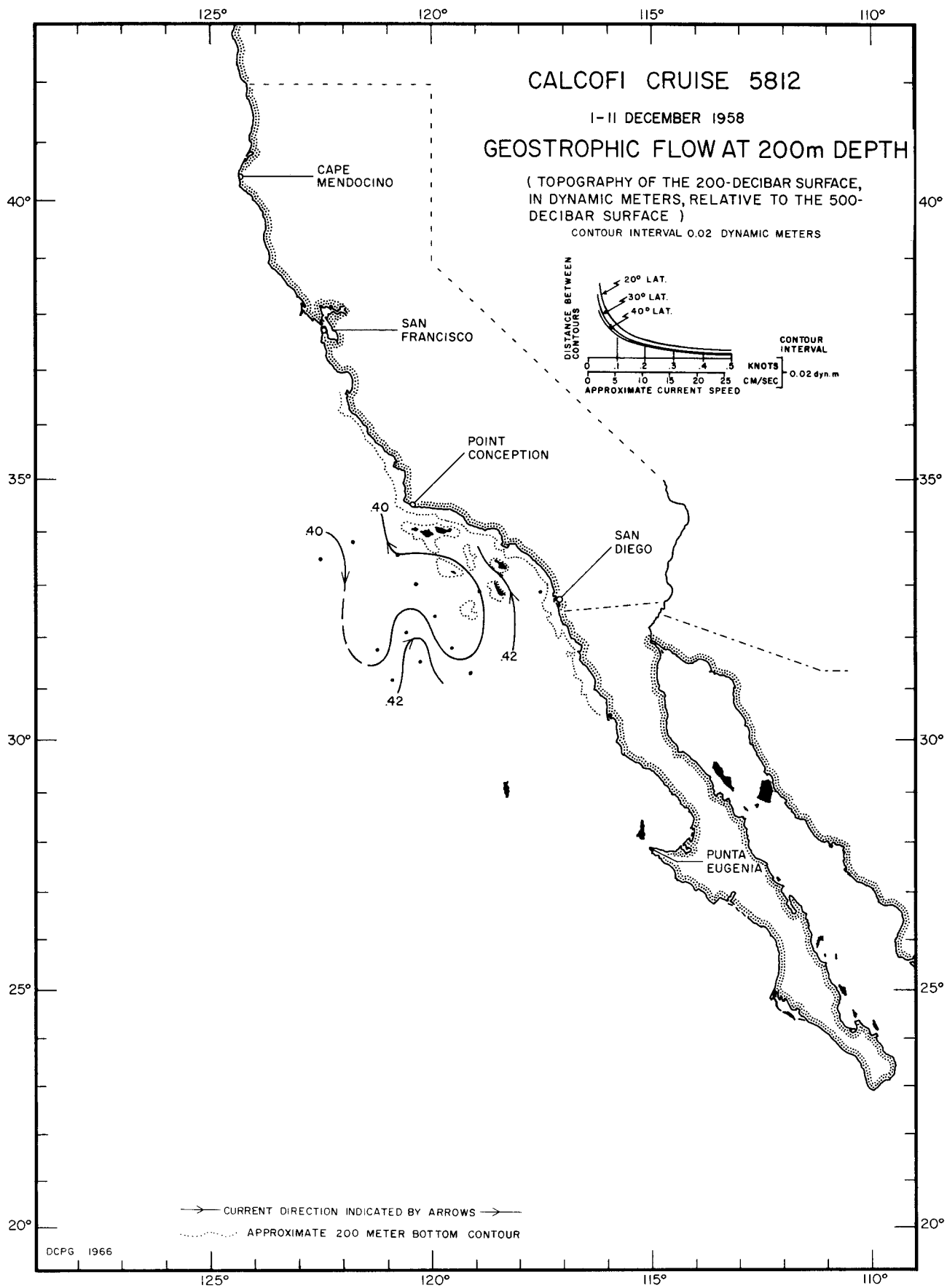
200/500 db  
5810



DCPG 1966

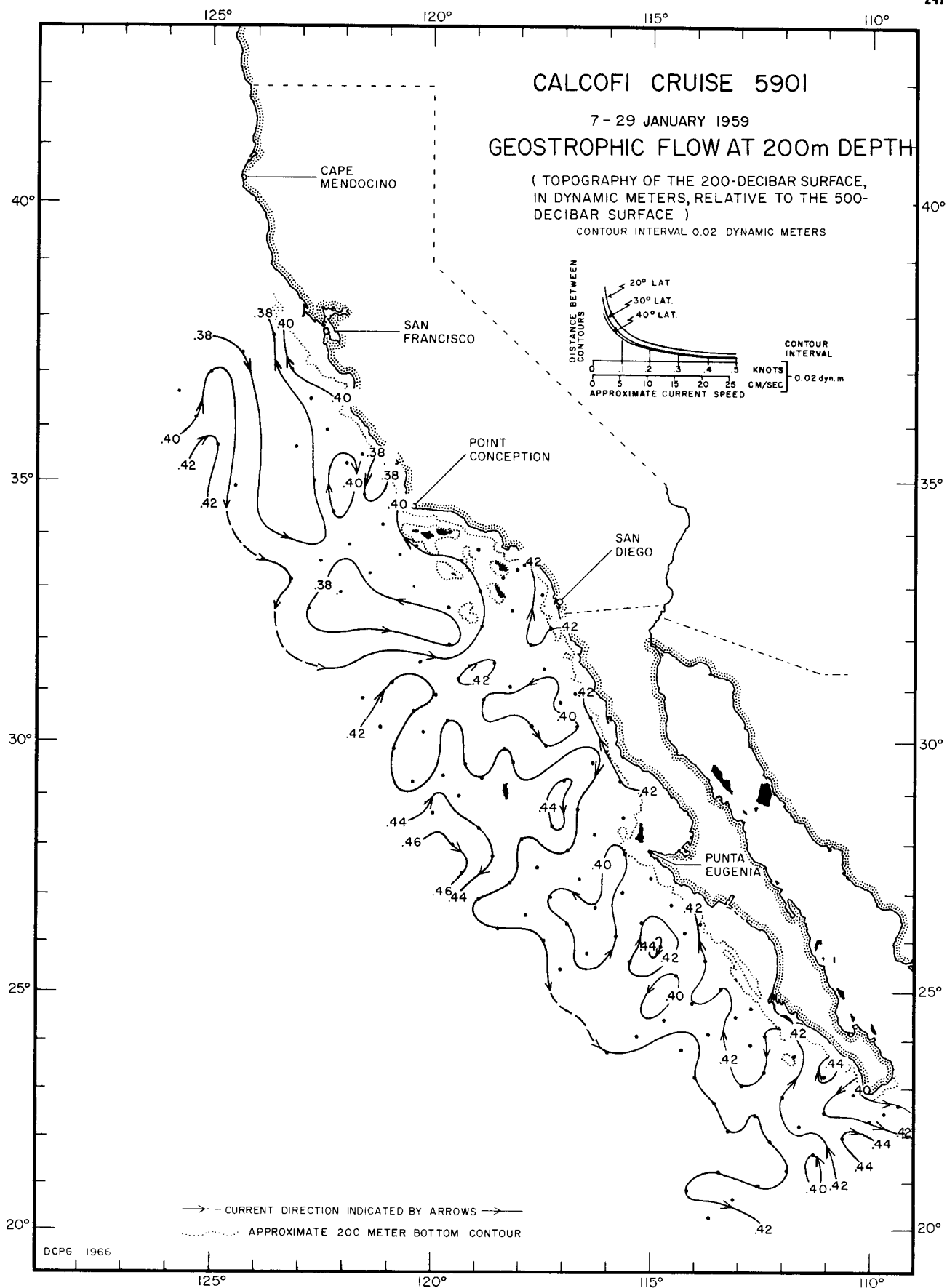
200/500 db  
5811



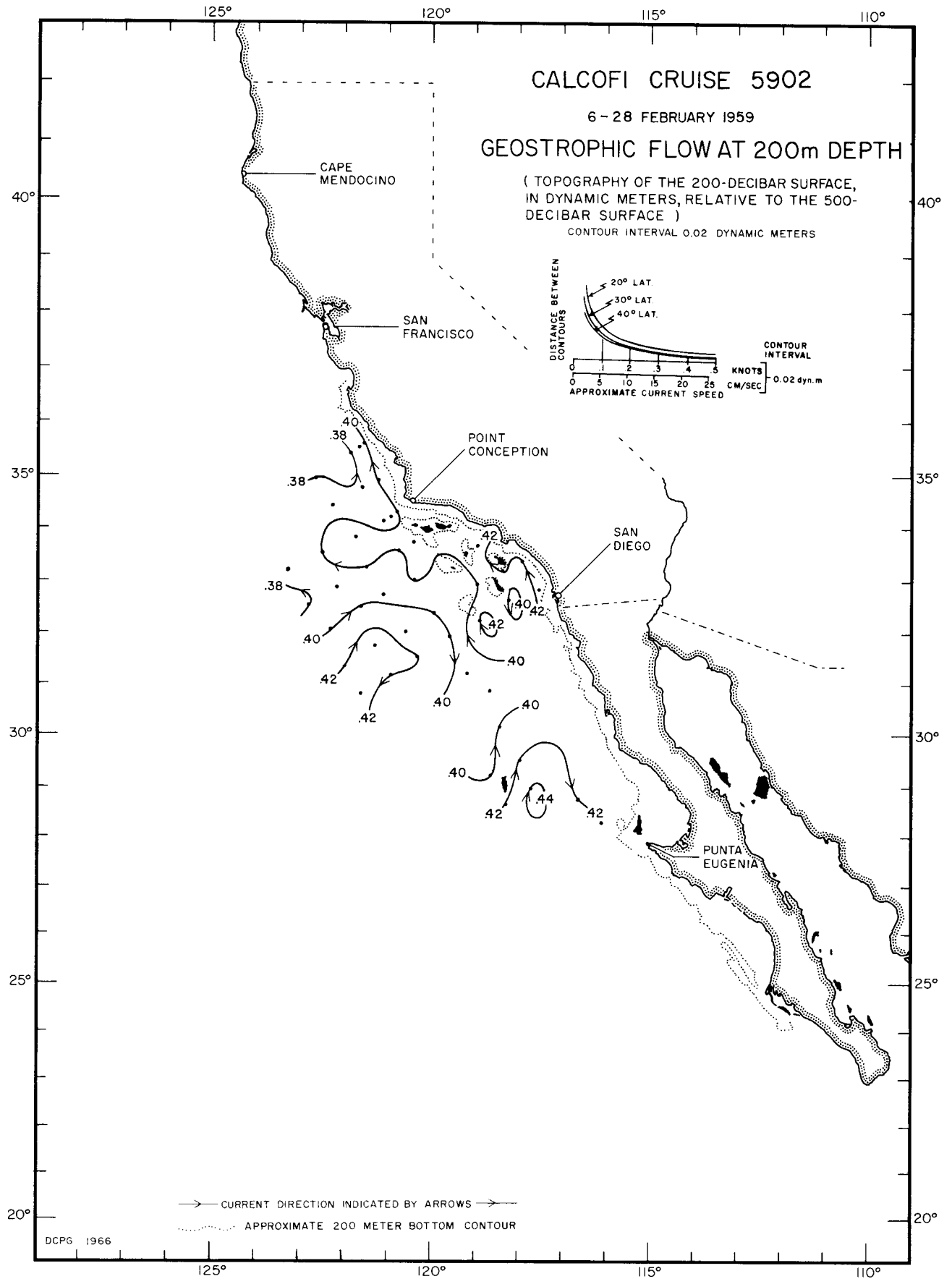


DCPG 1966

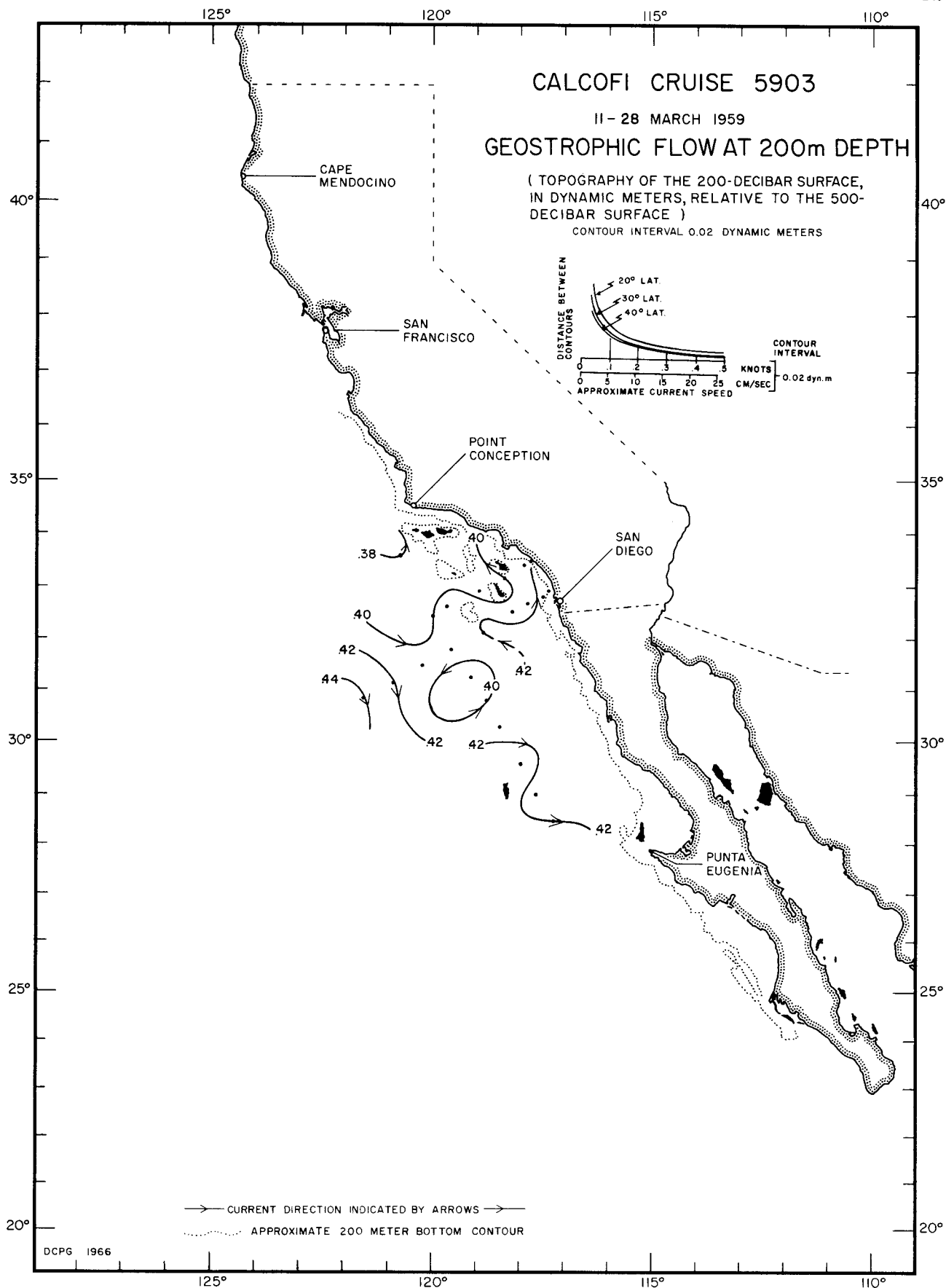
200/500 db  
5812



200/500 db  
5901

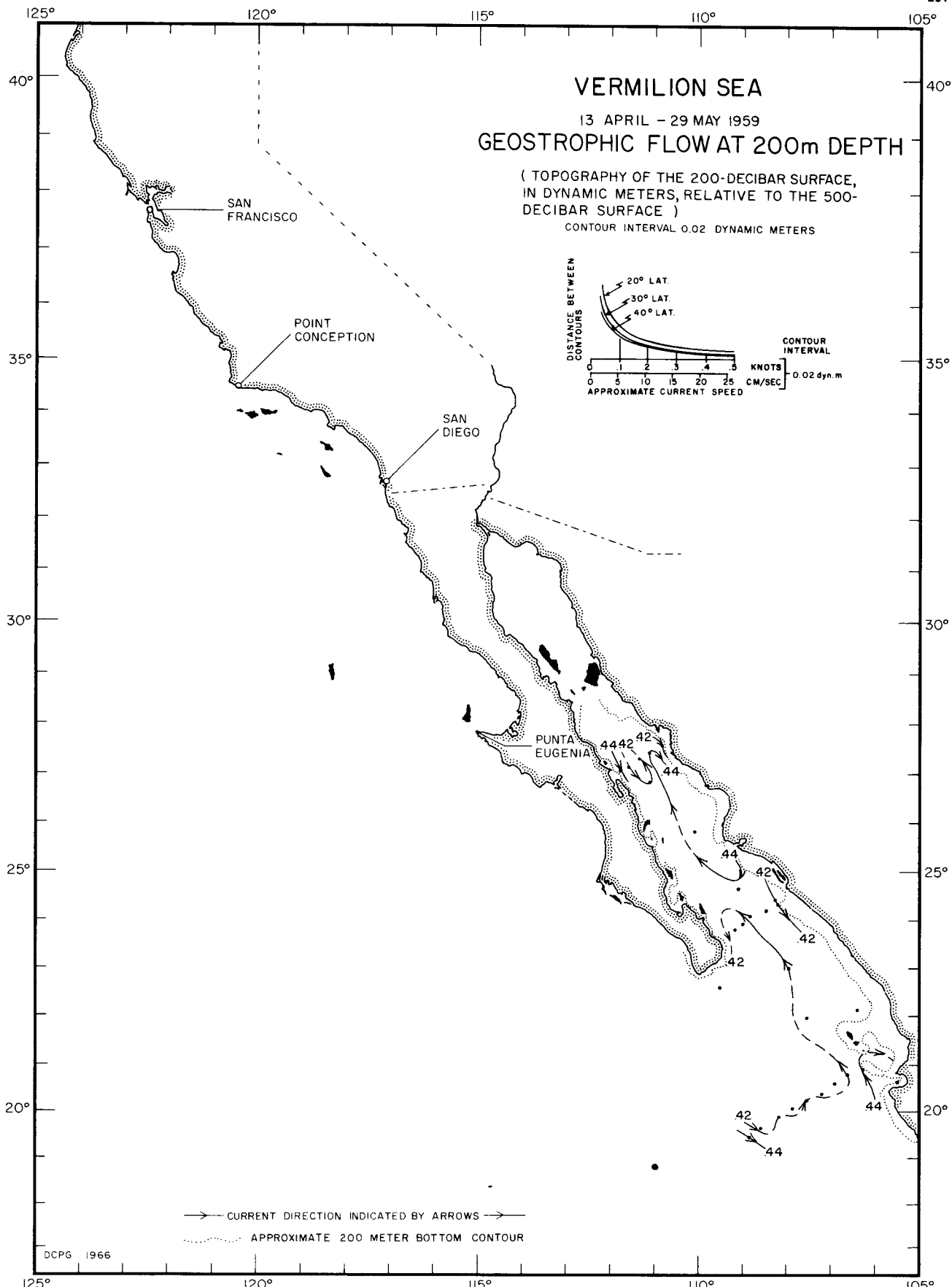


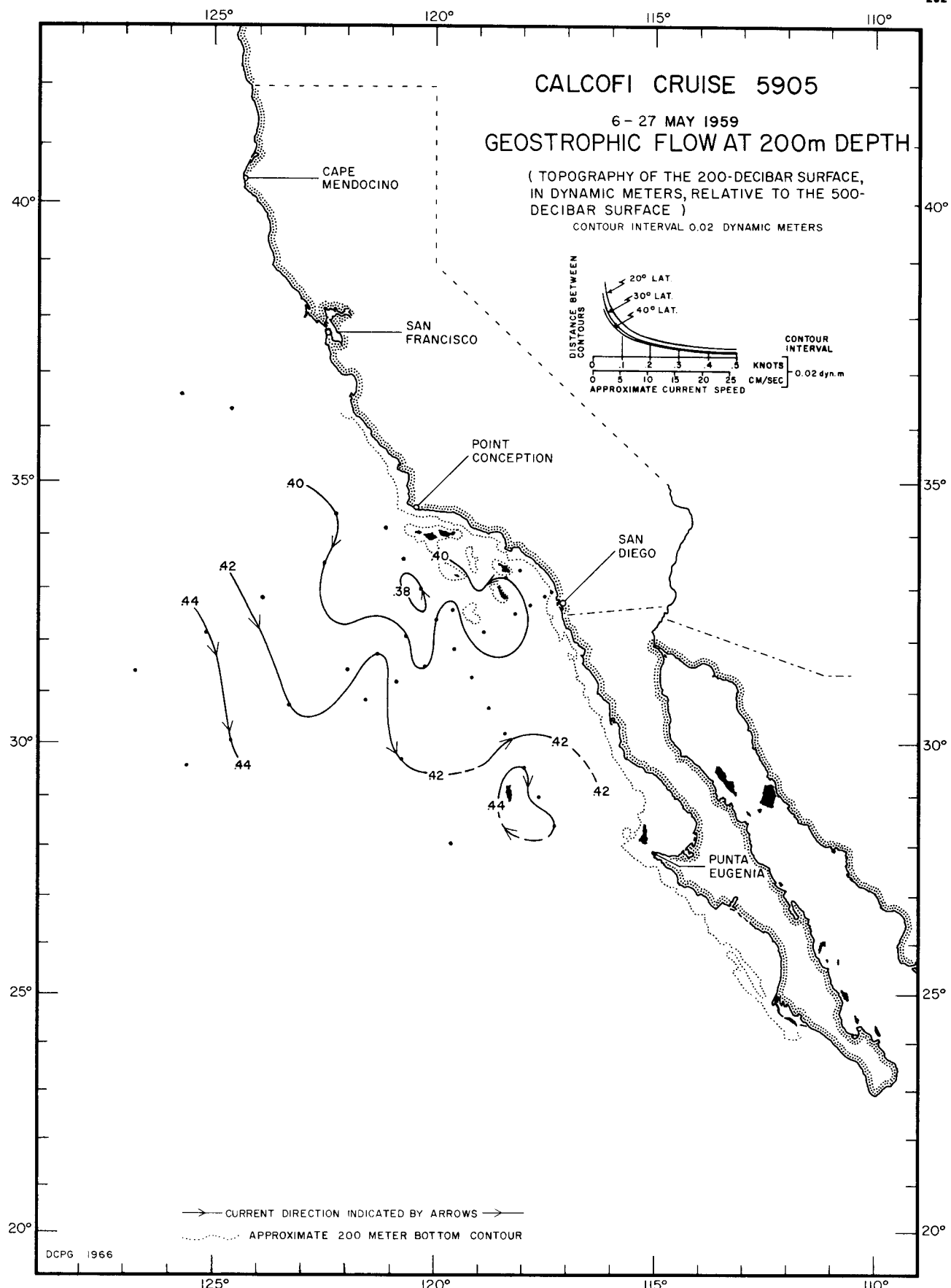
200/500 db  
5902



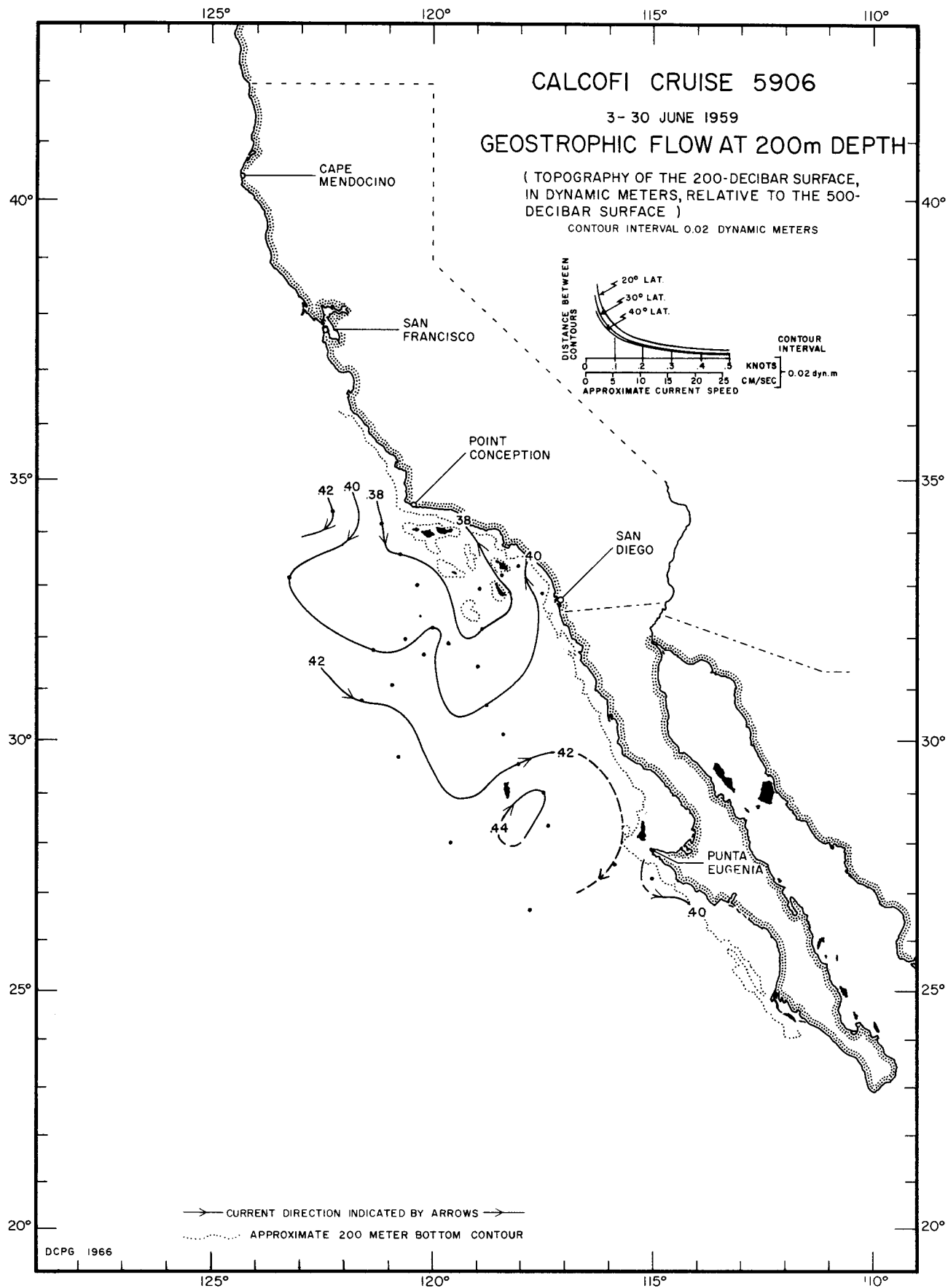
200/500 db  
5903





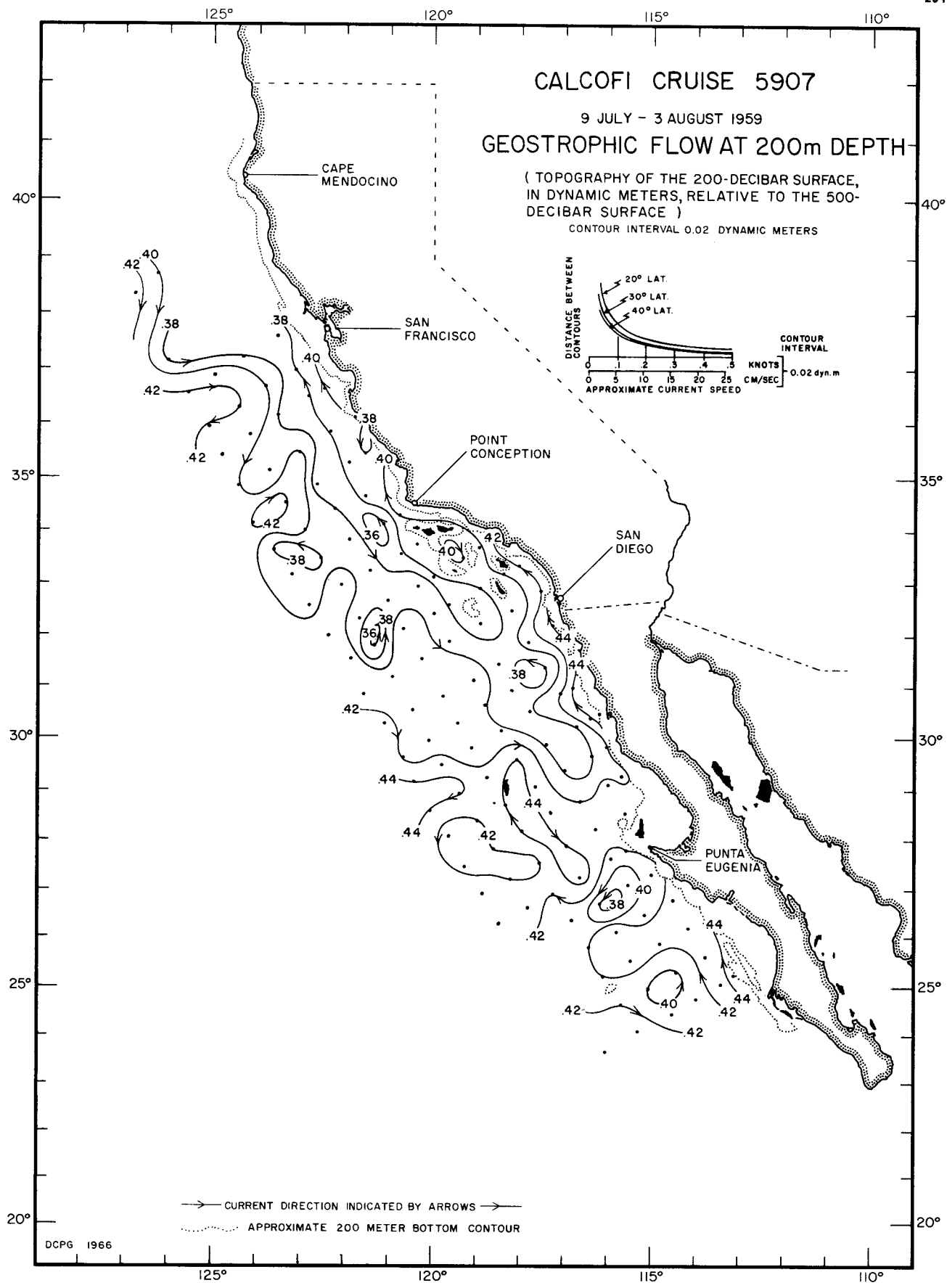


200/500 db  
5905

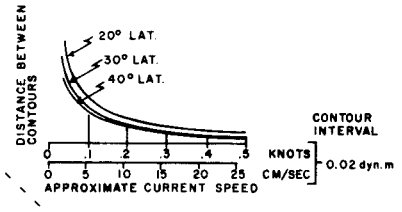


200/500 db  
5906



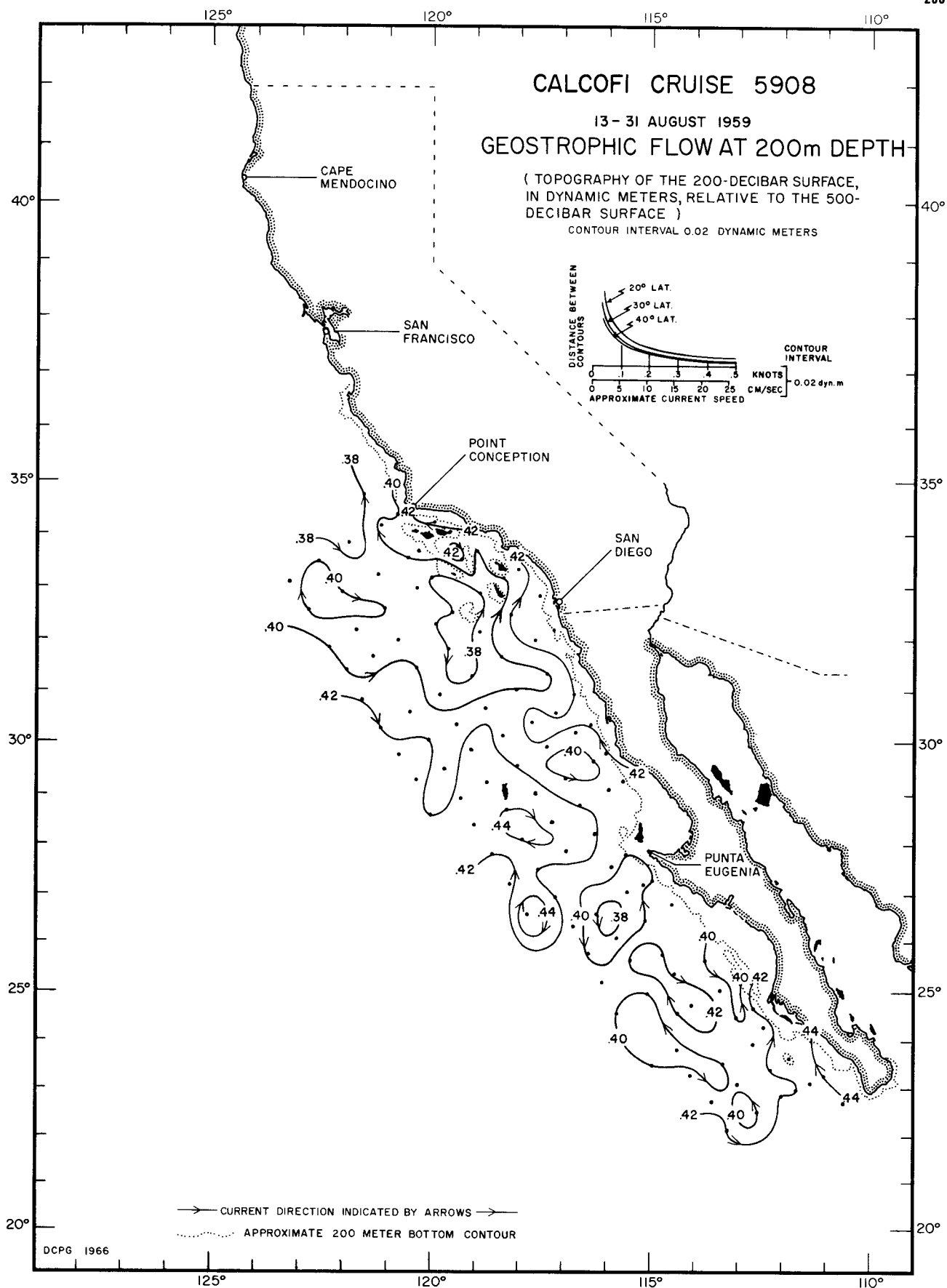


CALCOFI CRUISE 5907  
9 JULY - 3 AUGUST 1959  
GEOSTROPHIC FLOW AT 200m DEPTH  
( TOPOGRAPHY OF THE 200-DECIBAR SURFACE,  
IN DYNAMIC METERS, RELATIVE TO THE 500-  
DECIBAR SURFACE )  
CONTOUR INTERVAL 0.02 DYNAMIC METERS

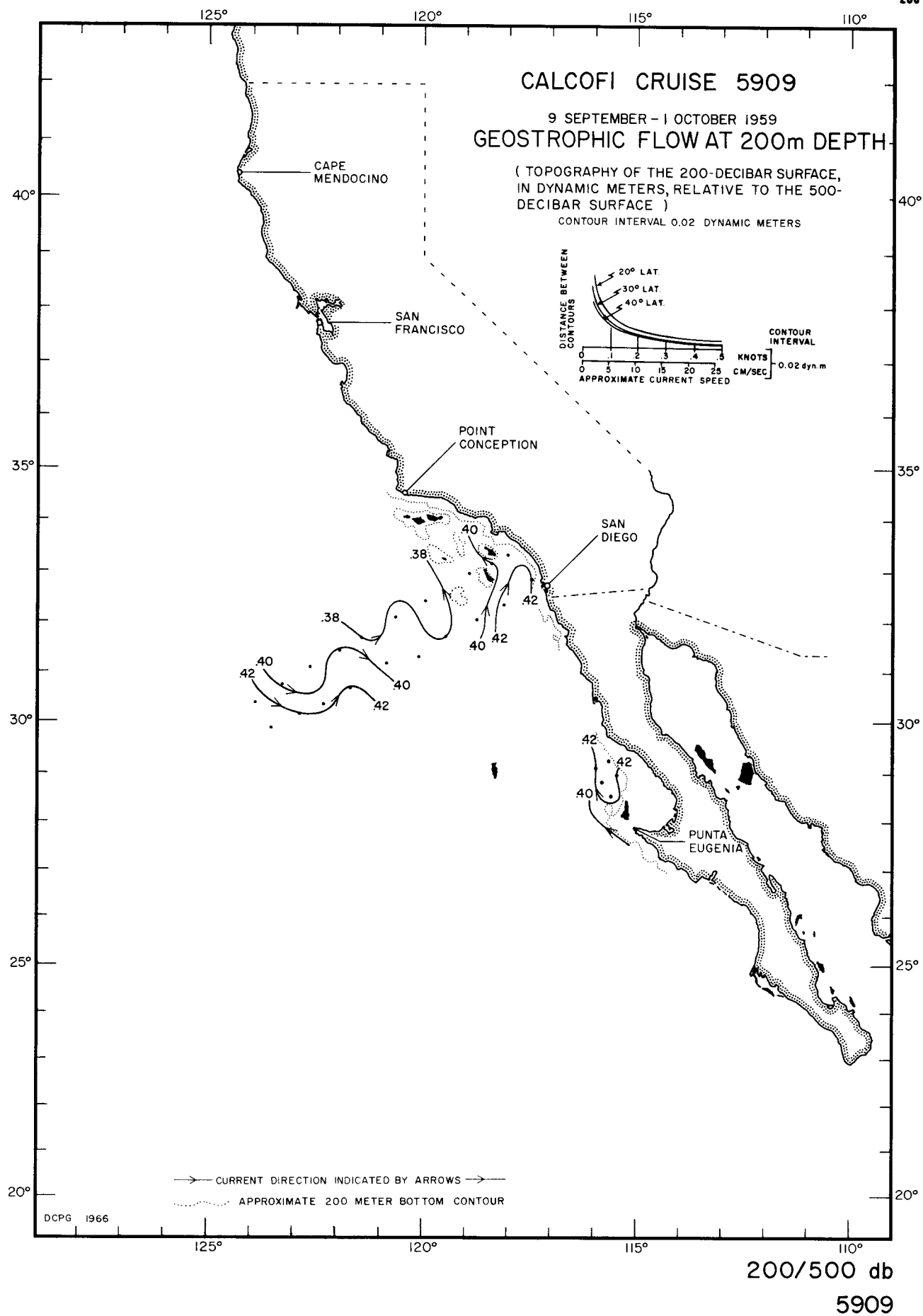


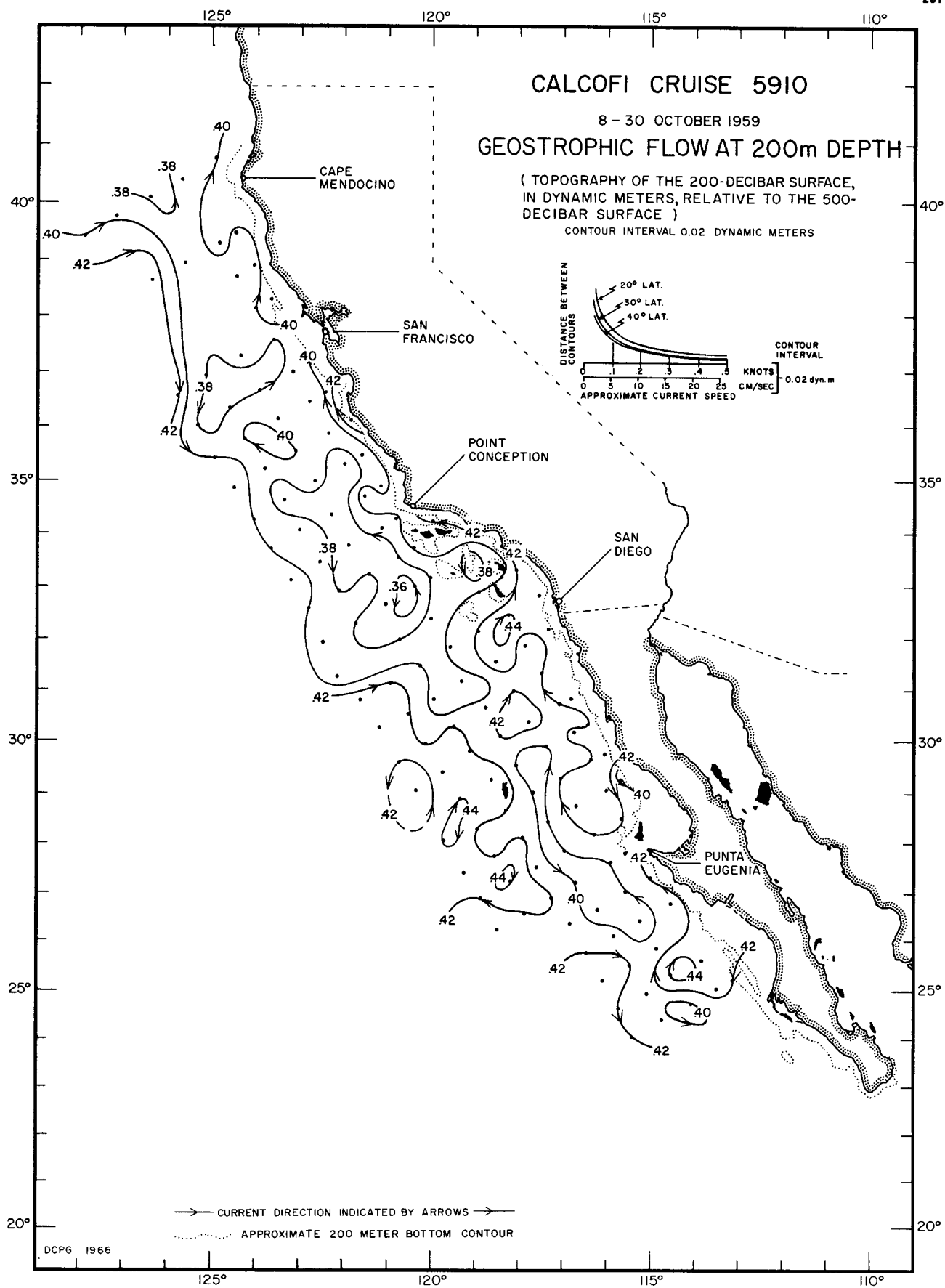
DCPG 1966

200/500 db  
5907

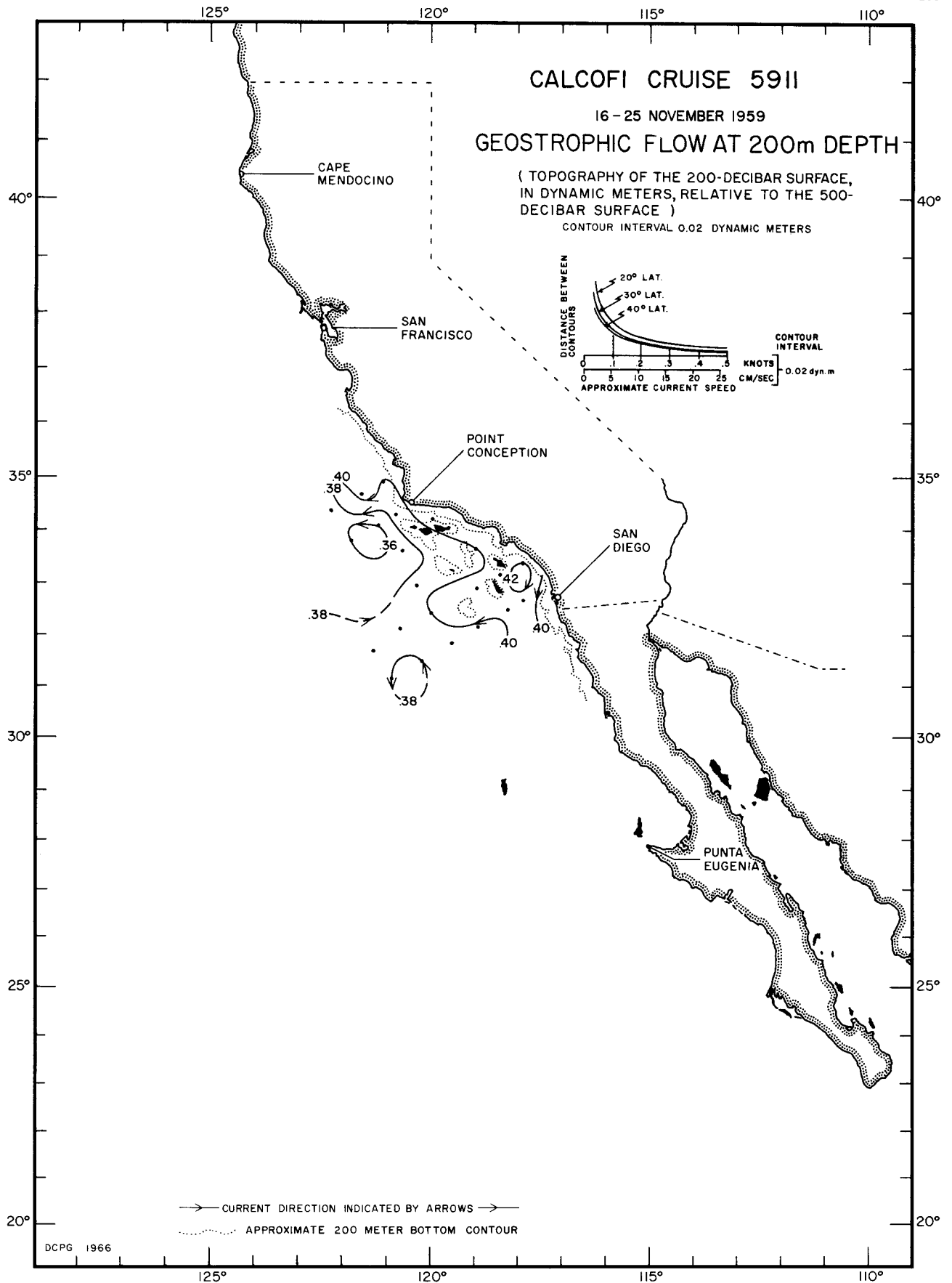


200/500 db  
5908

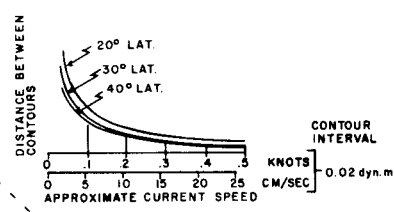
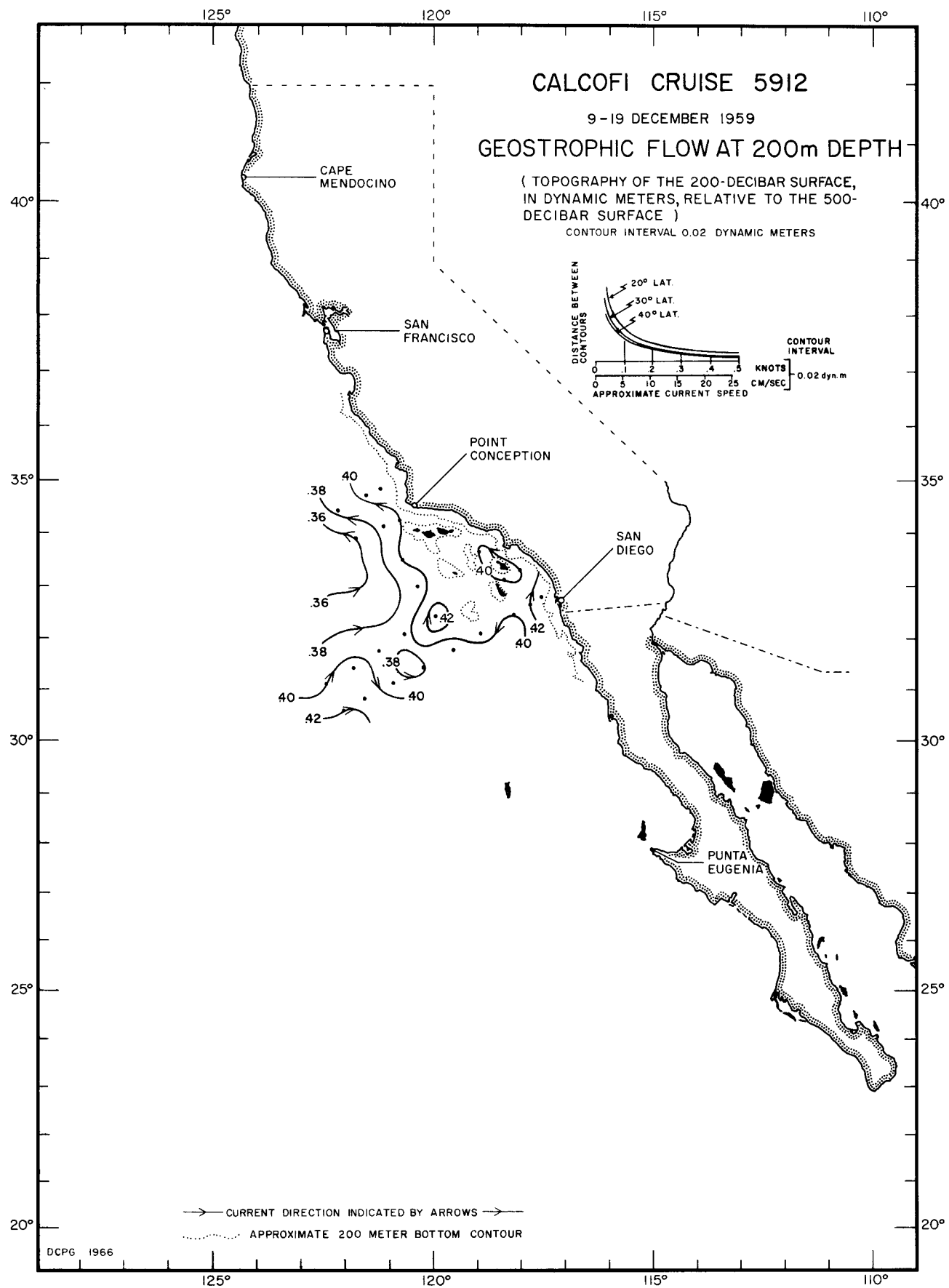


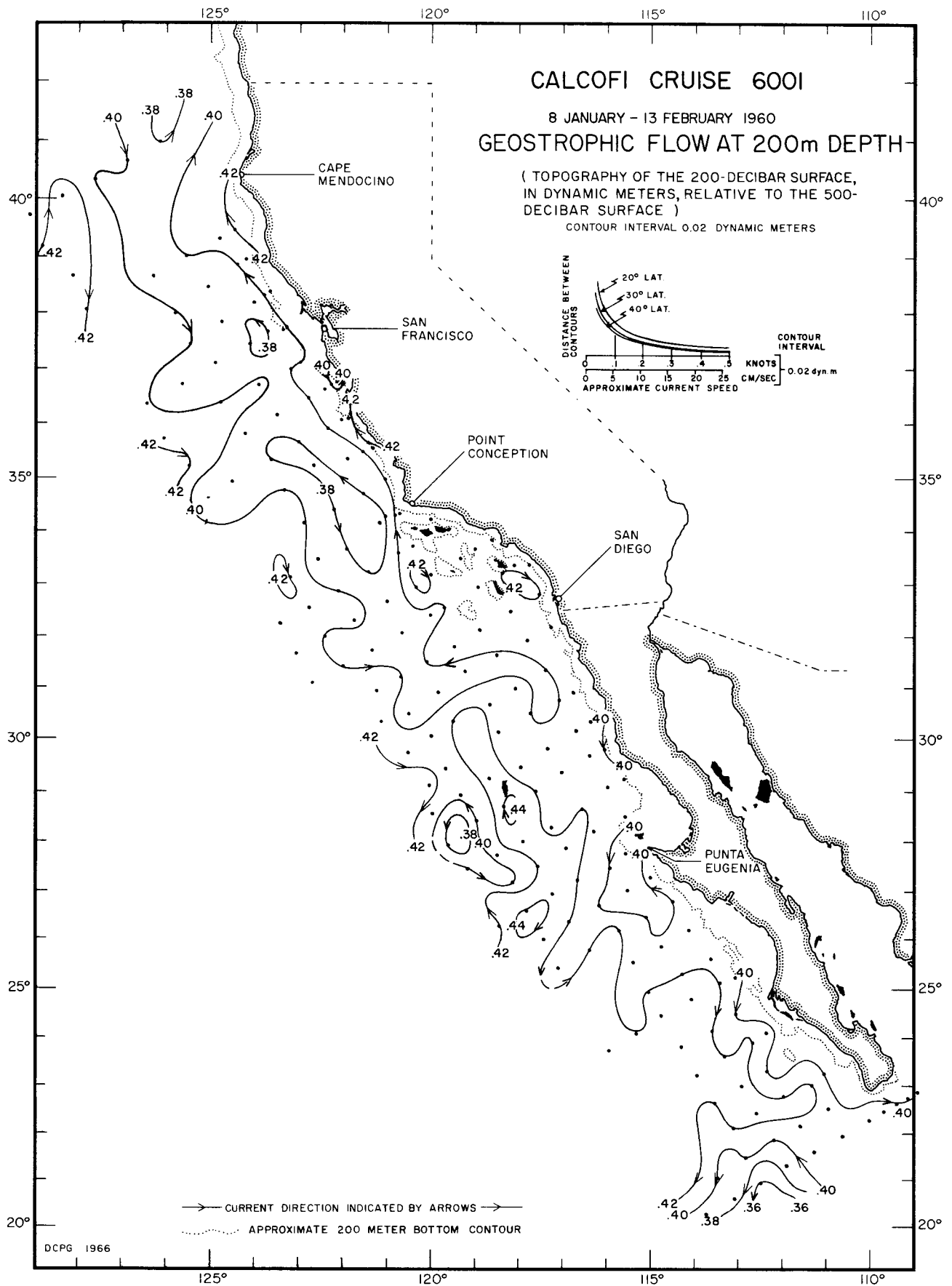


200/500 db  
5910



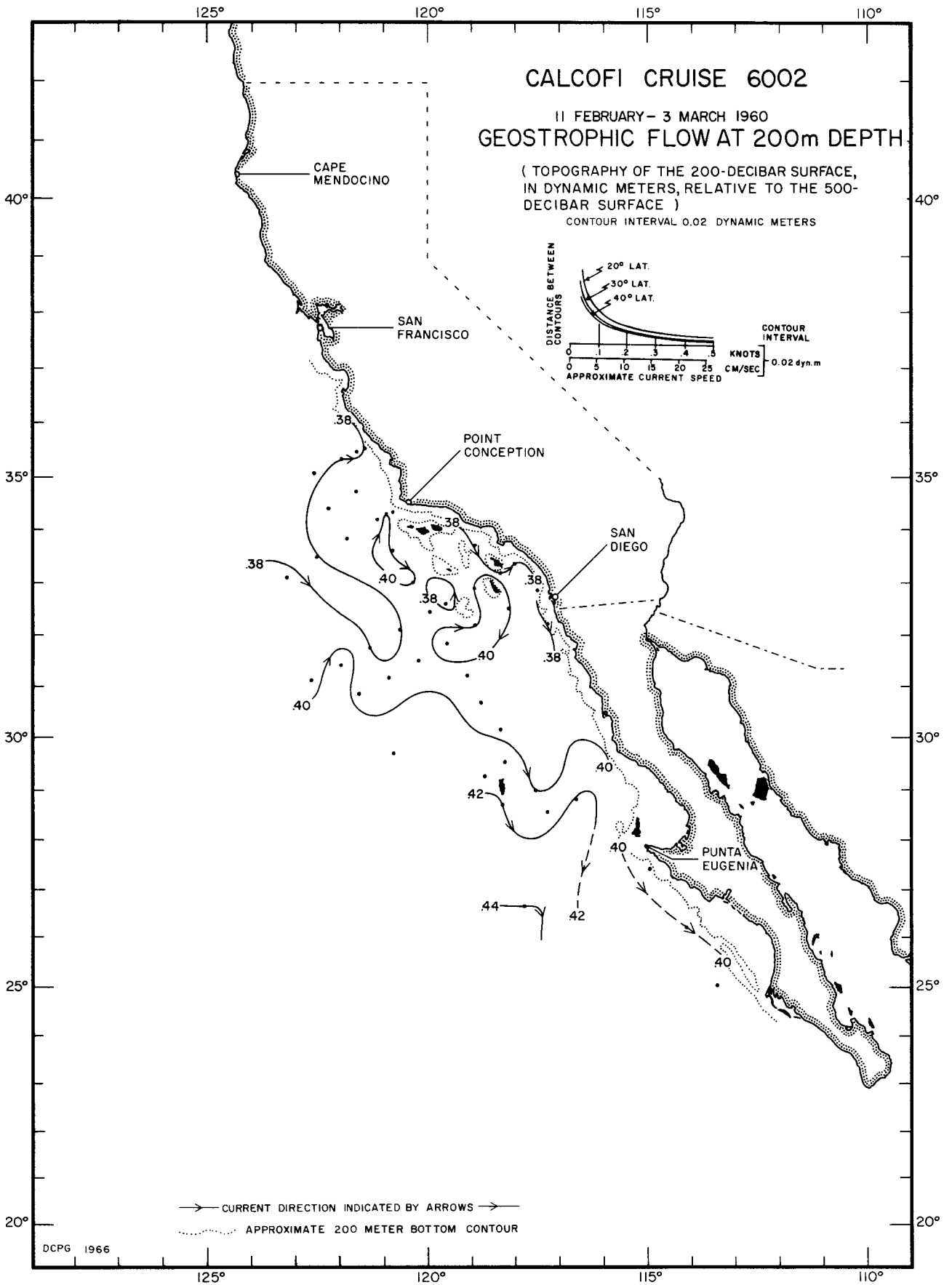
200/500 db  
5911





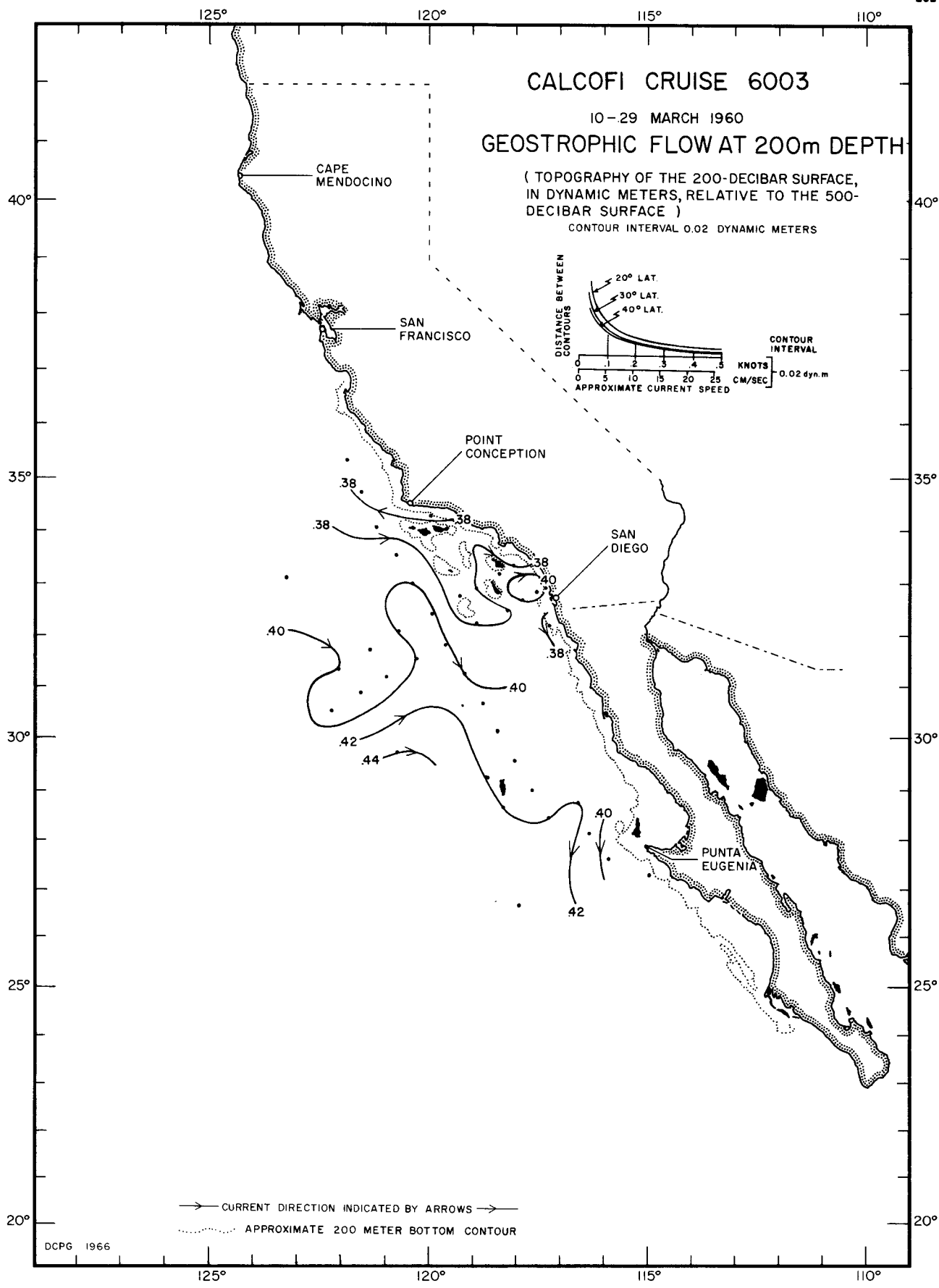
DCPG 1966

200/500 db  
 6001

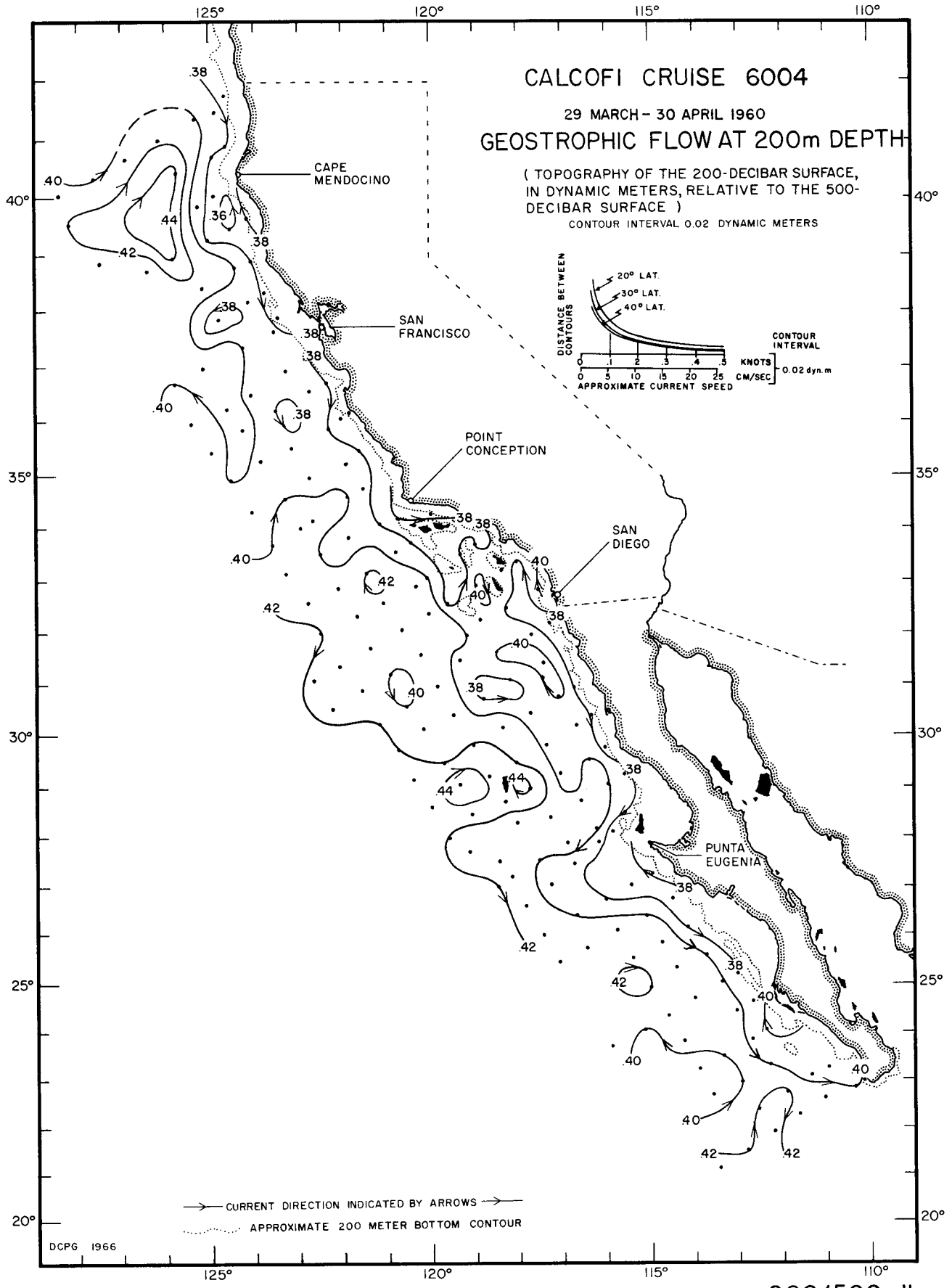


200/500 db  
6002

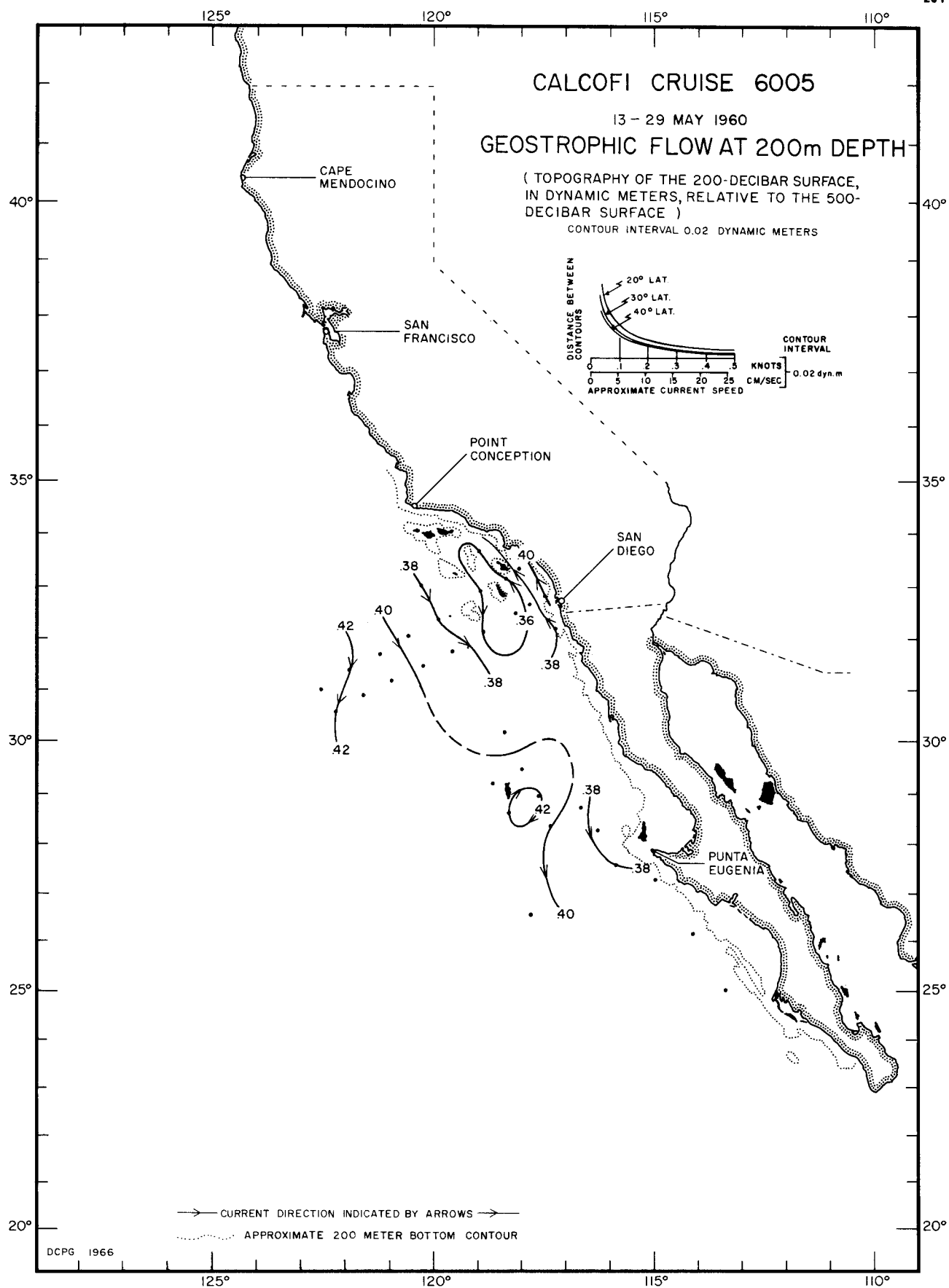




200/500 db  
6003

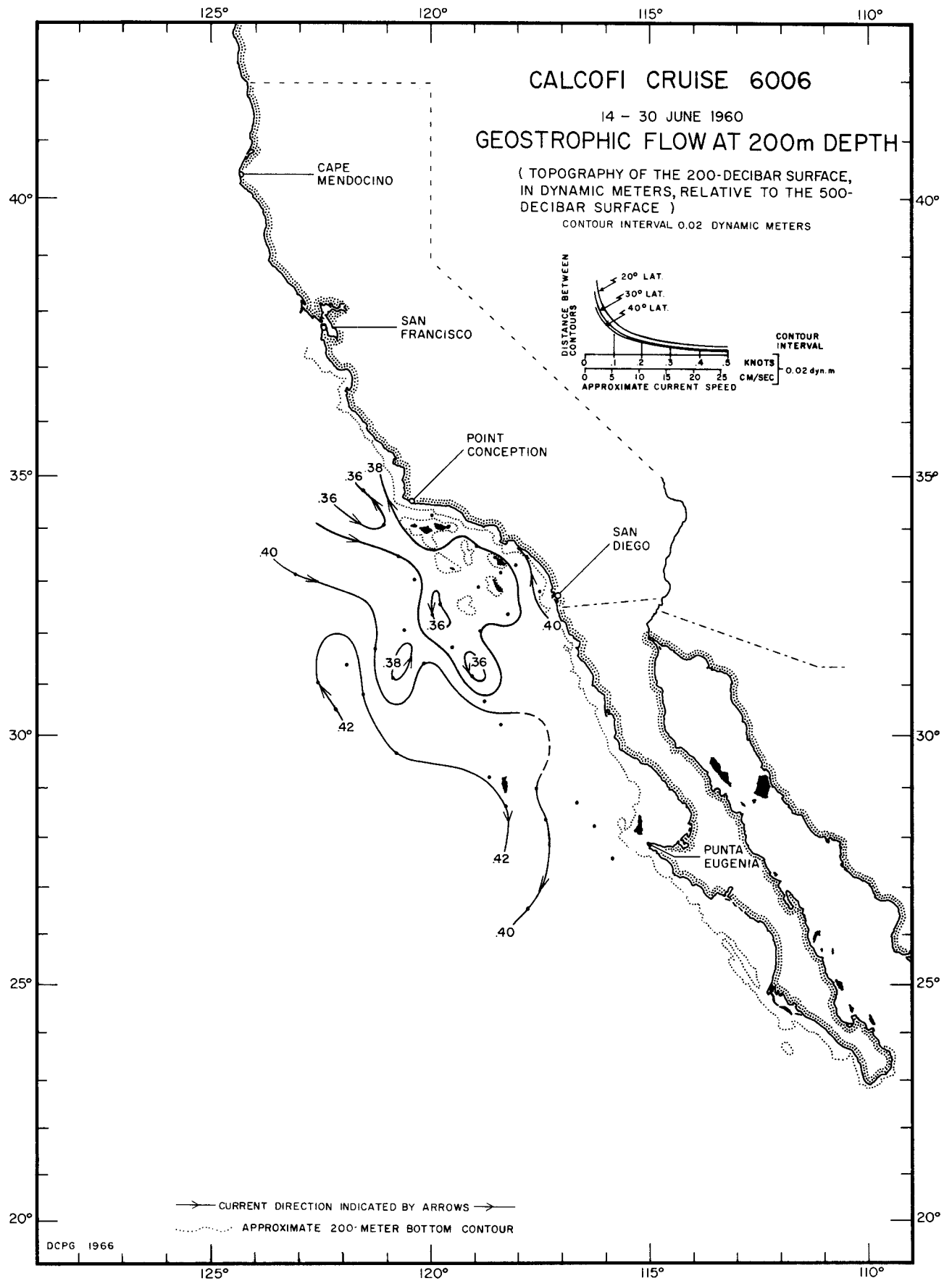


200/500 db  
6004

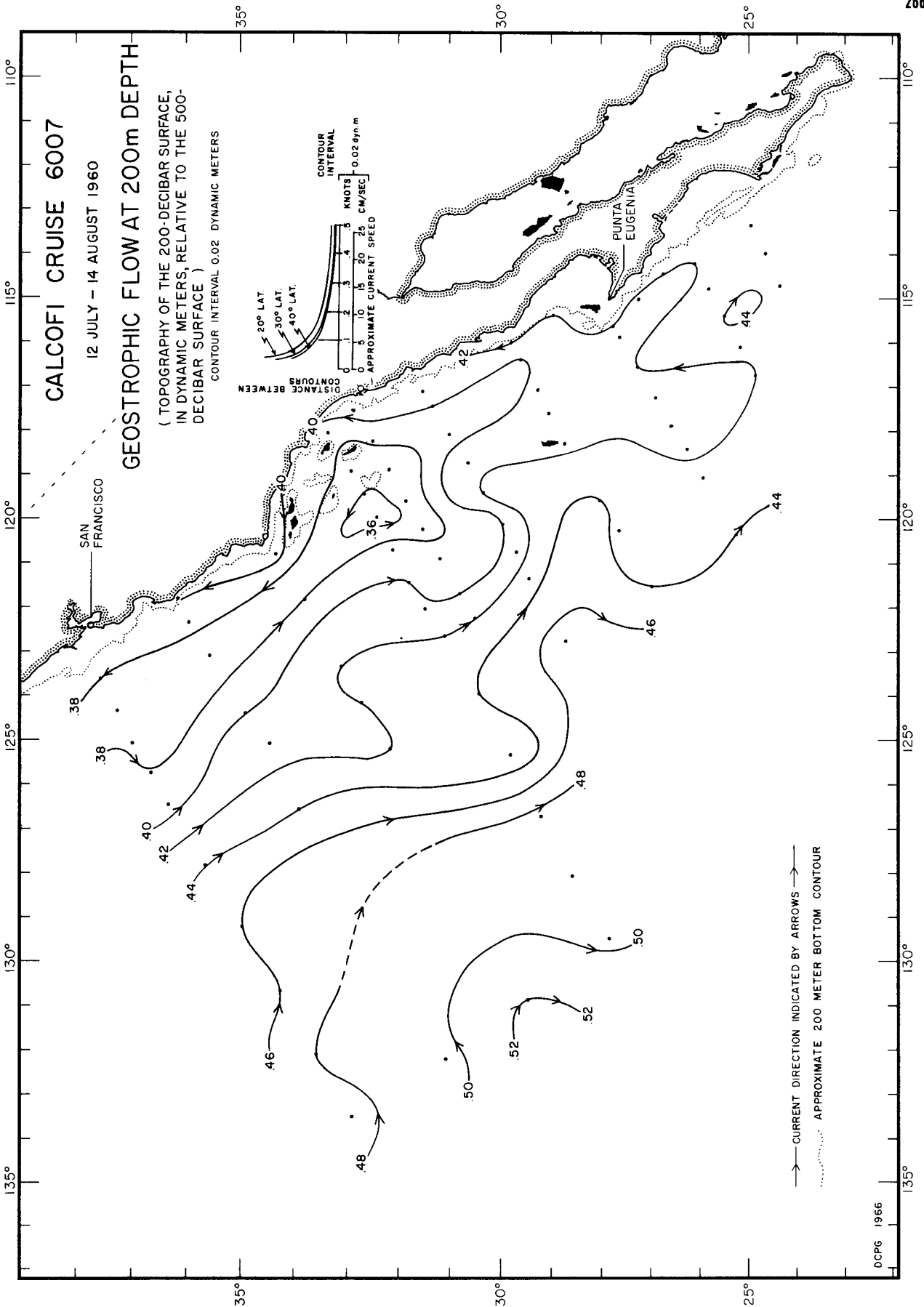


DCPG 1966

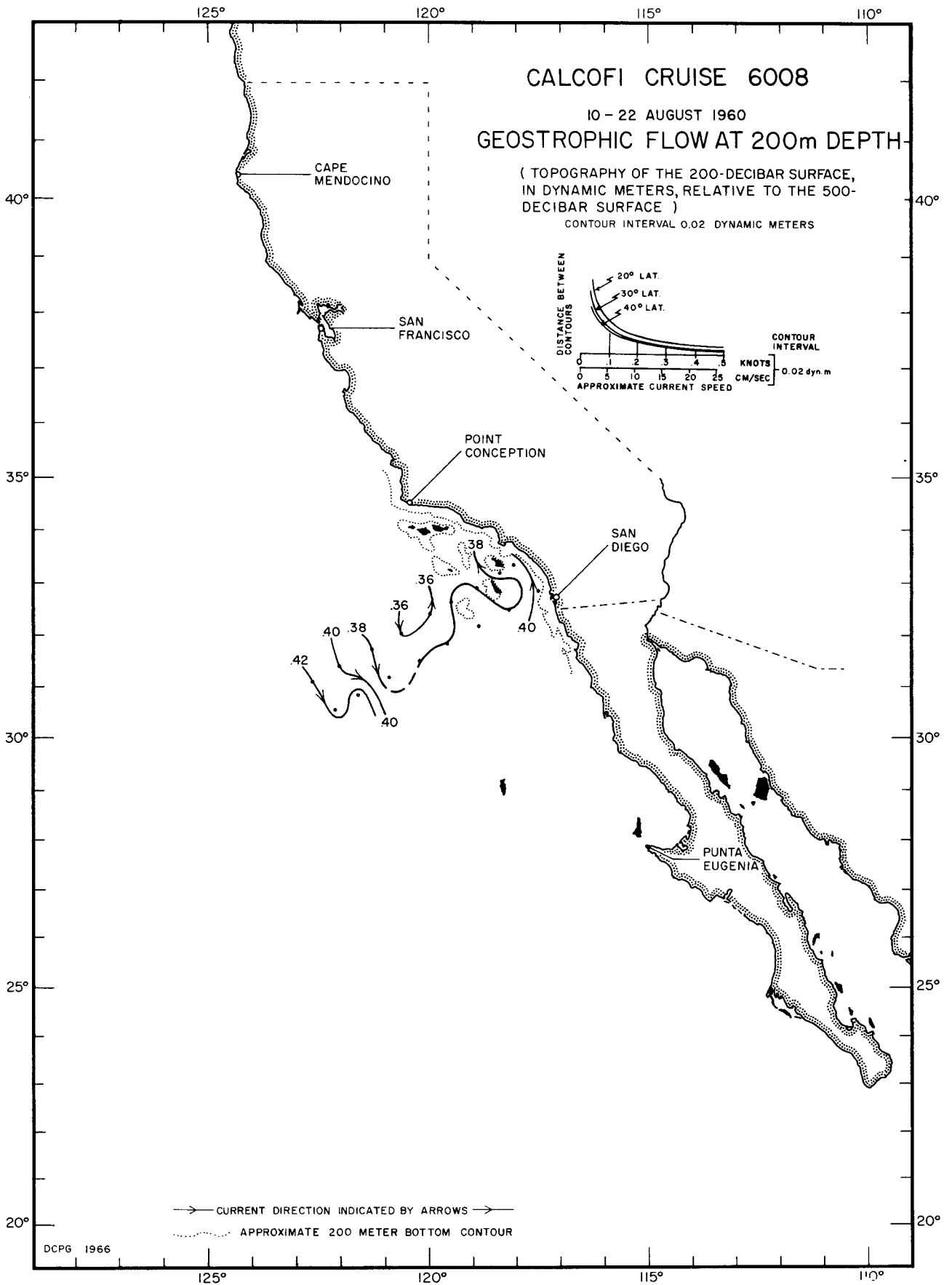
200/500 db  
6005



200/500 db  
6006

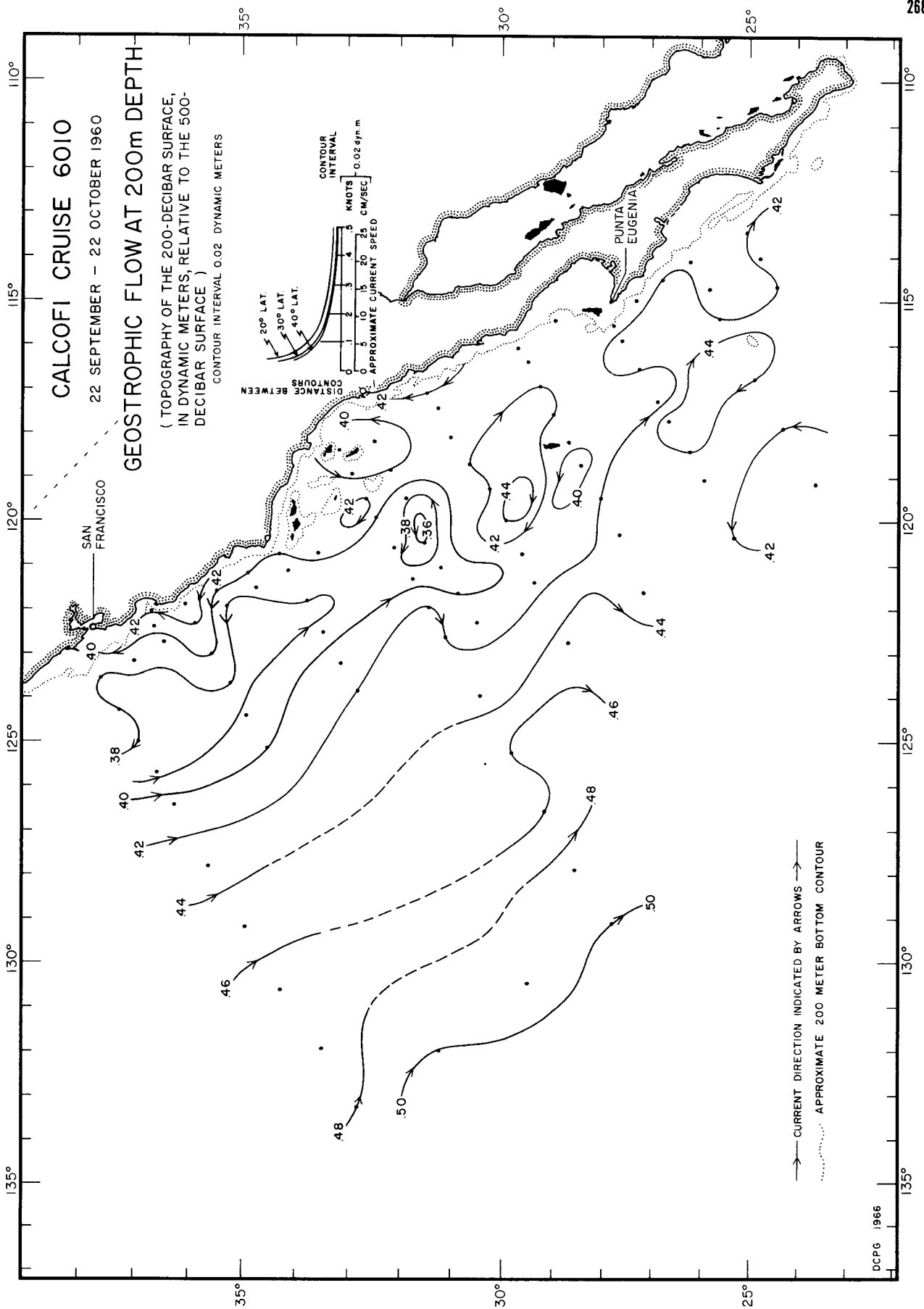


200/500 db  
6007



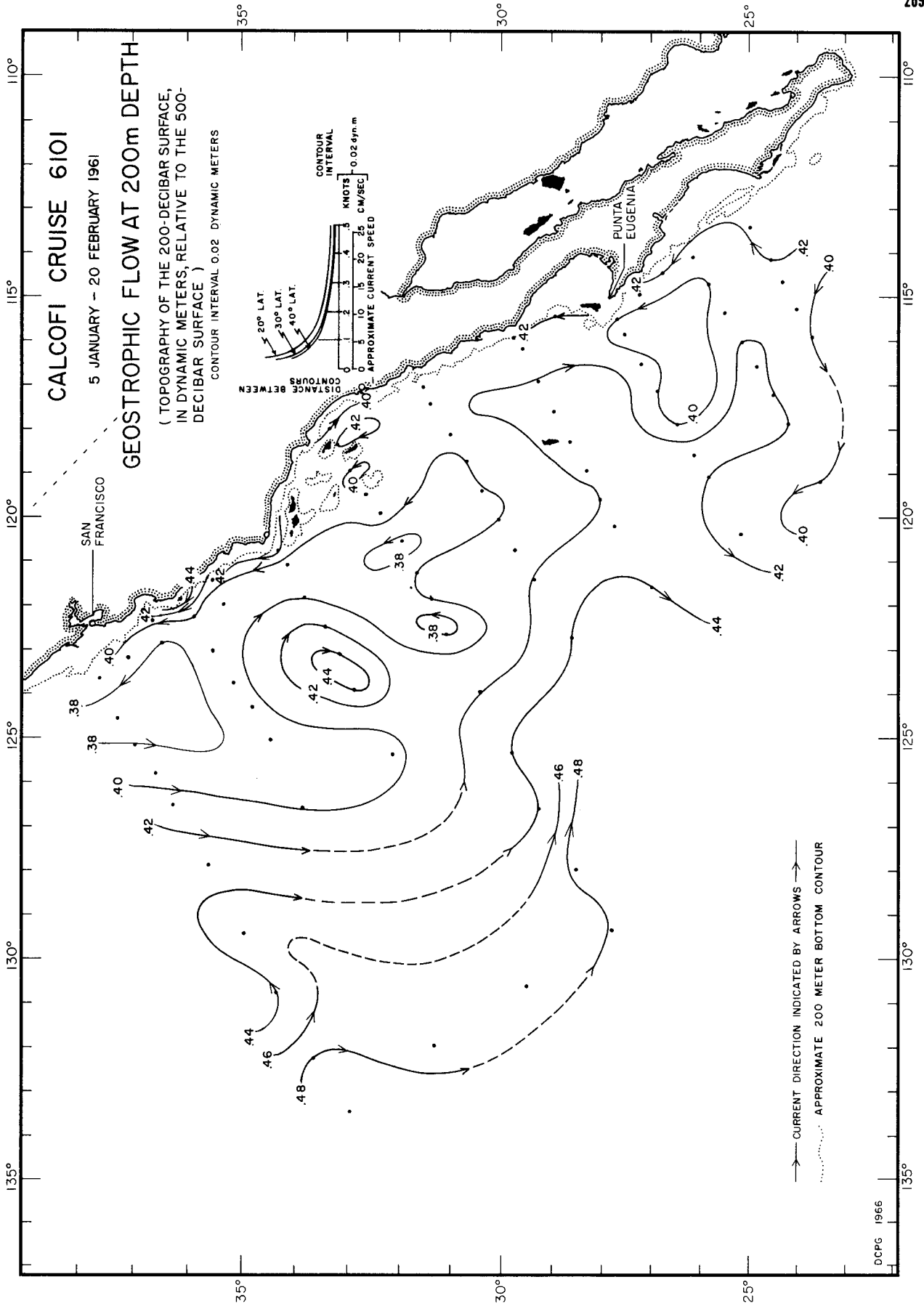
DCPG 1966

200/500 db  
6008



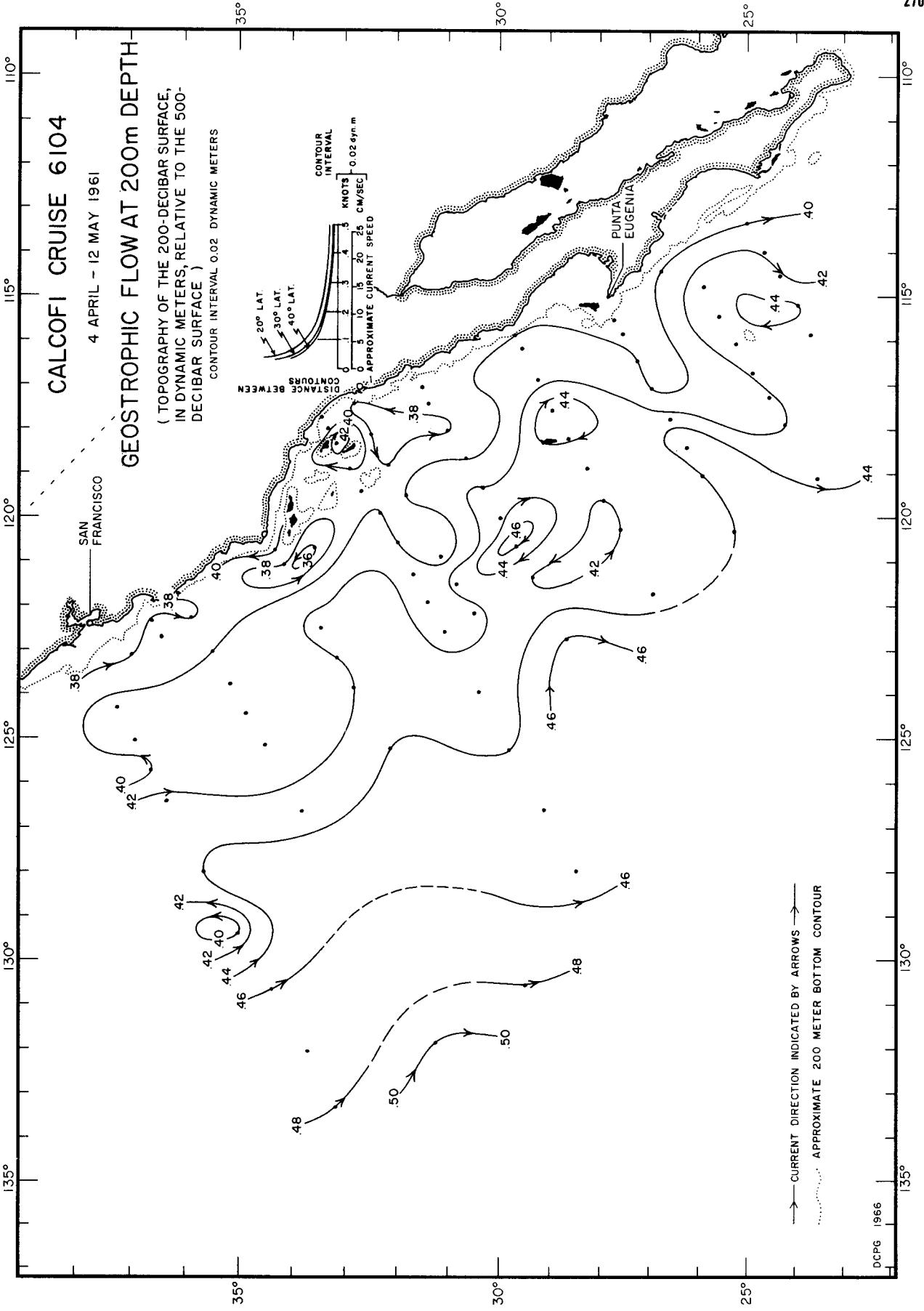
200/500 db  
6010

DCP6 1966

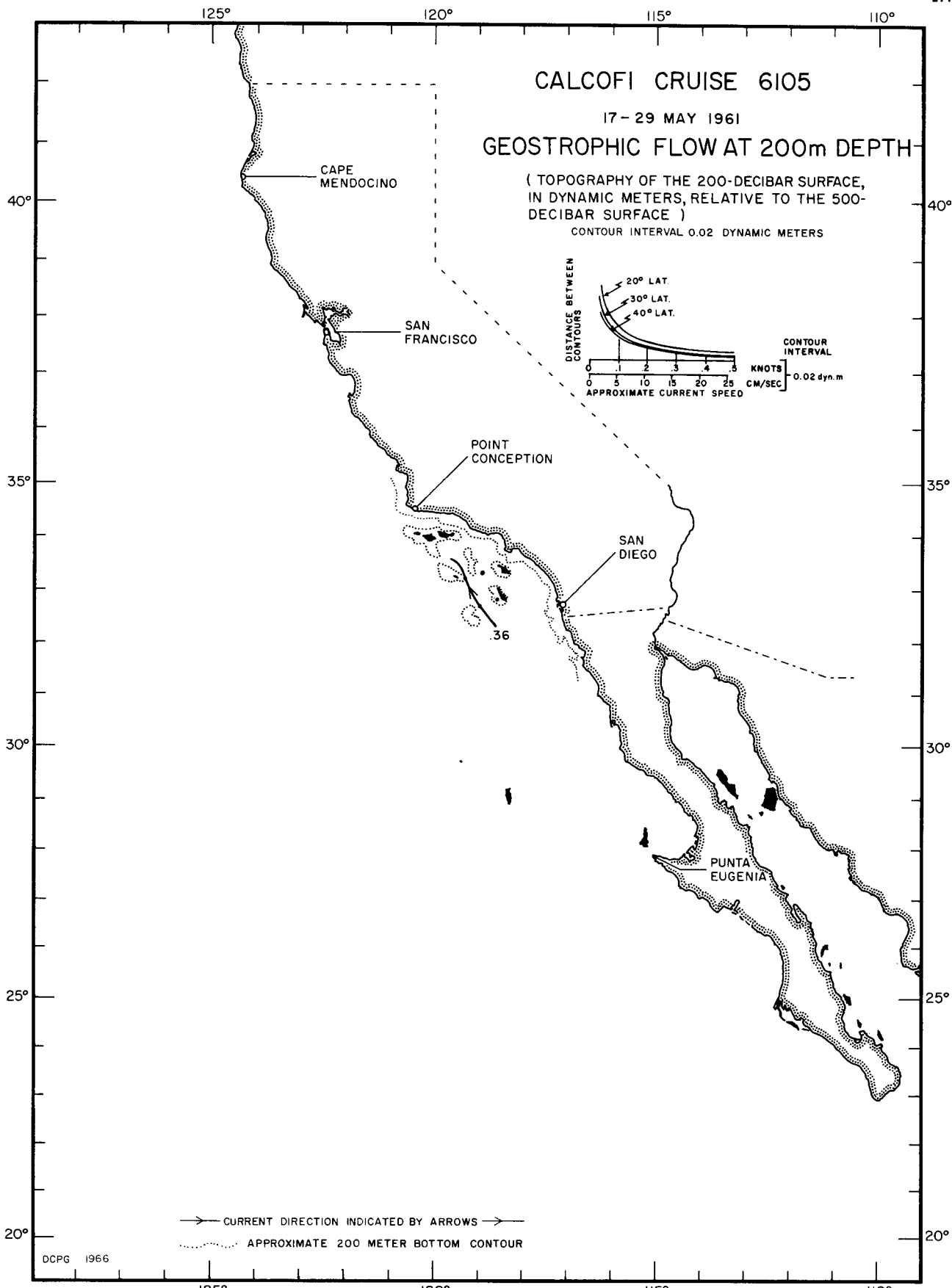


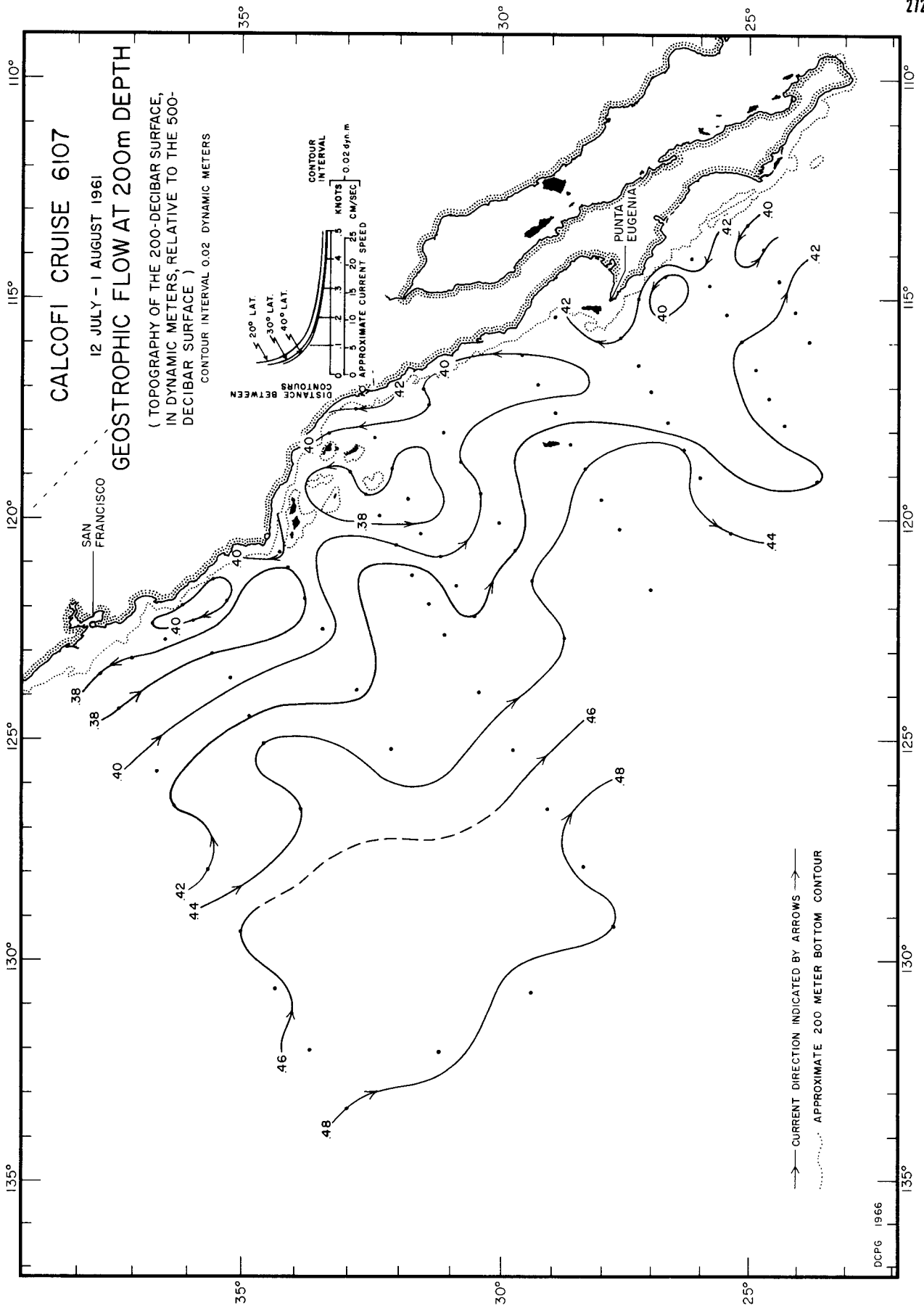
200/500 db  
6101





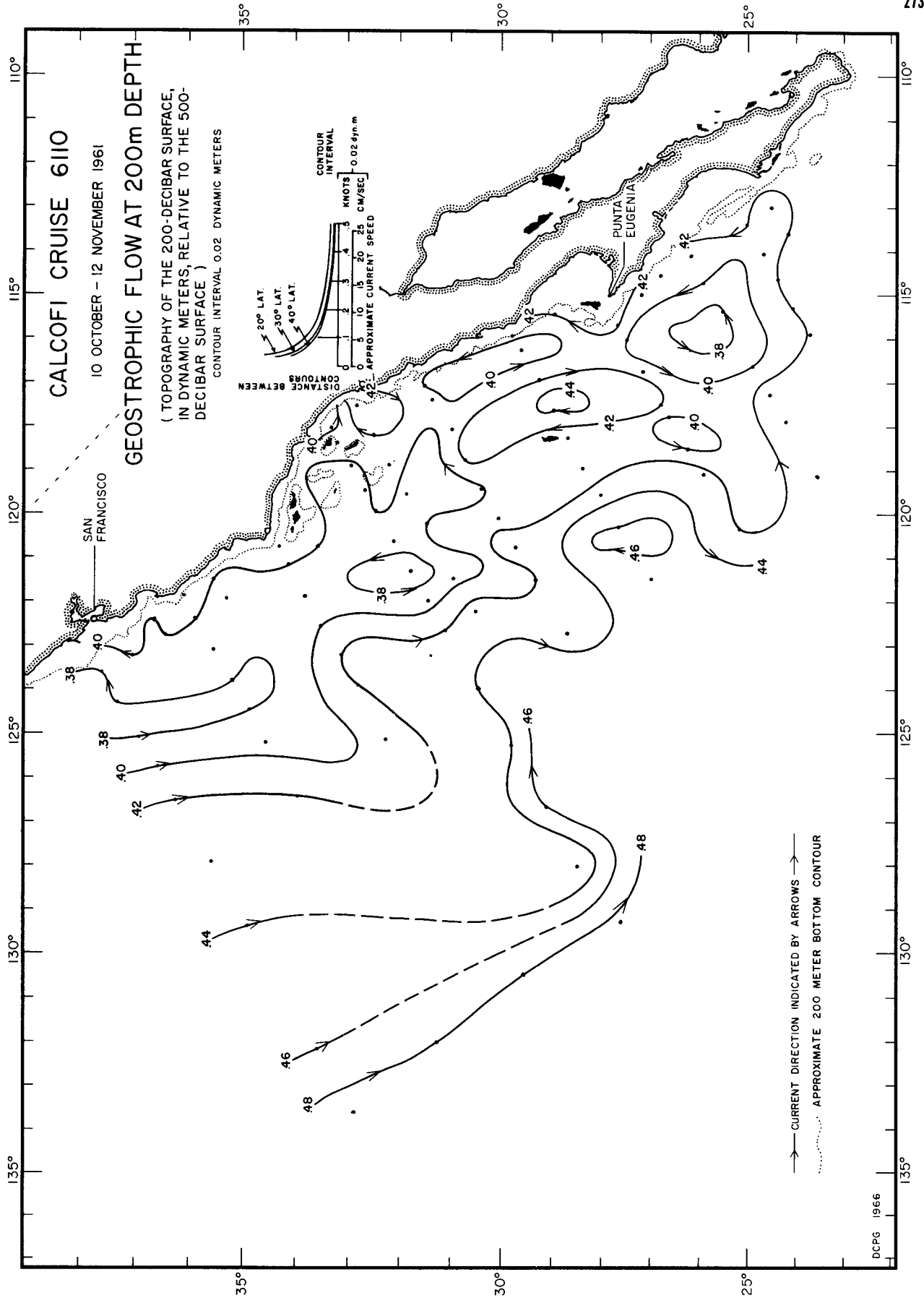
200/500 db  
6104





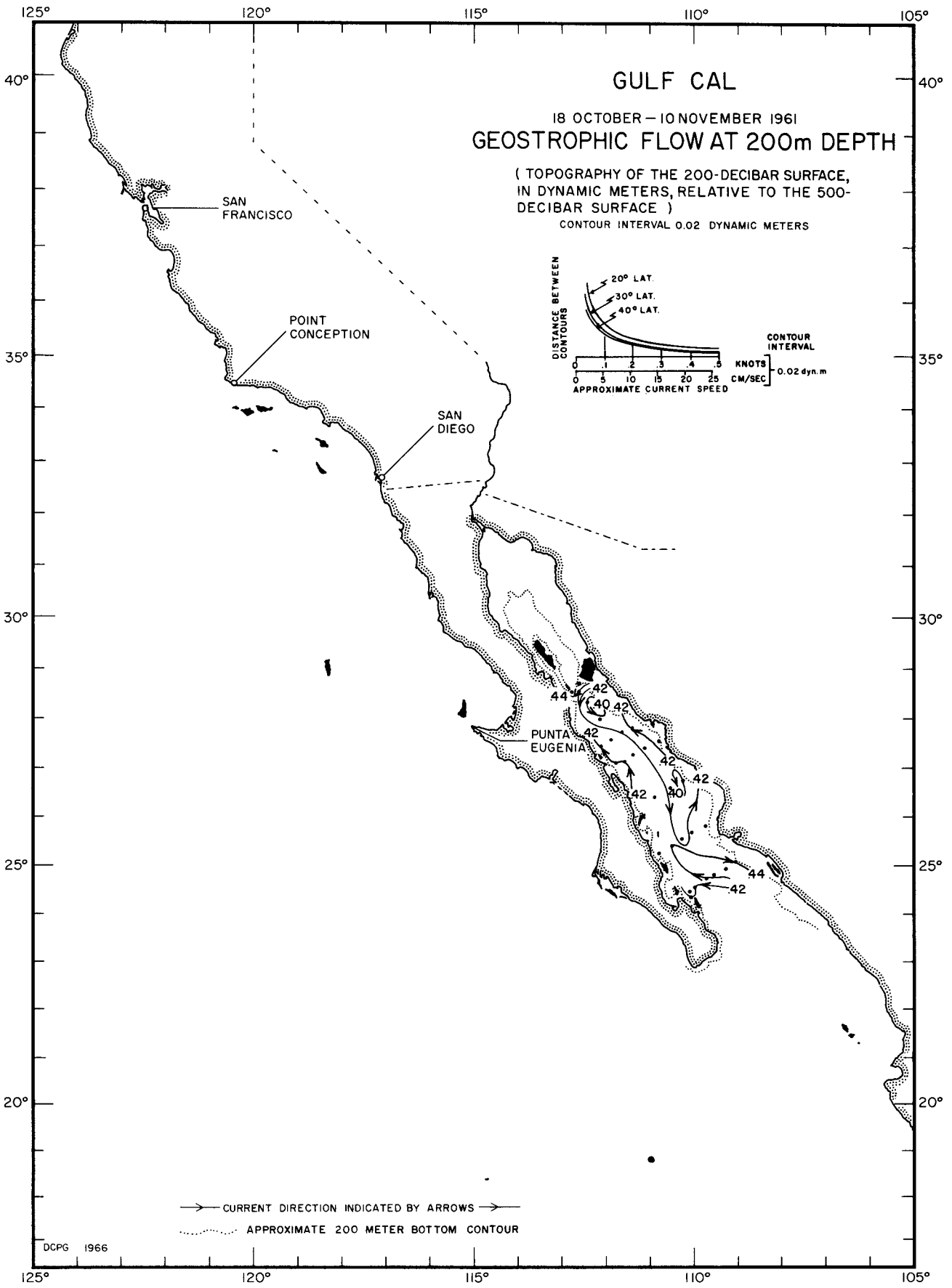
200/500 db  
6107

DCP6 1966

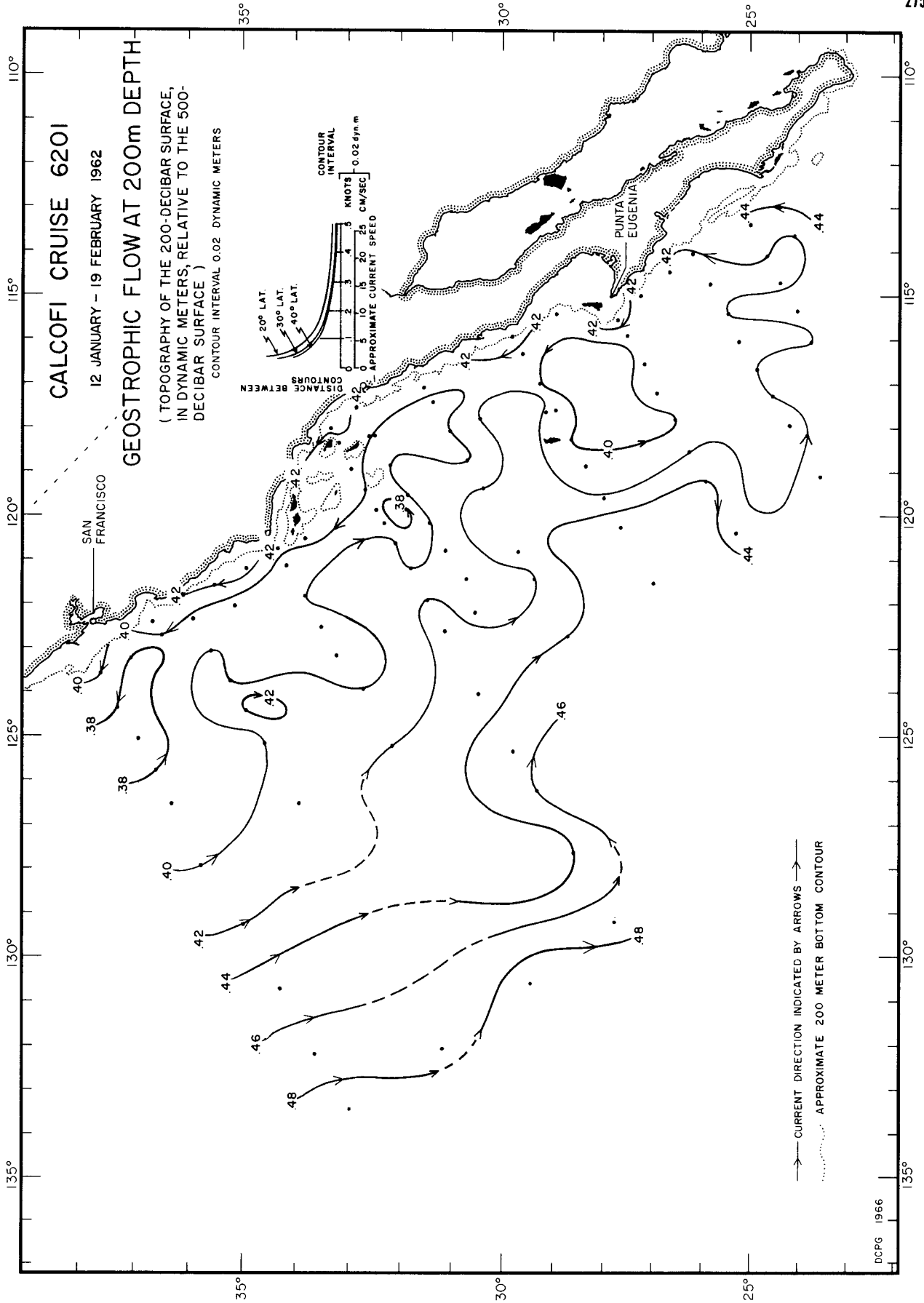


200/500 db  
6110

DCPG 1966

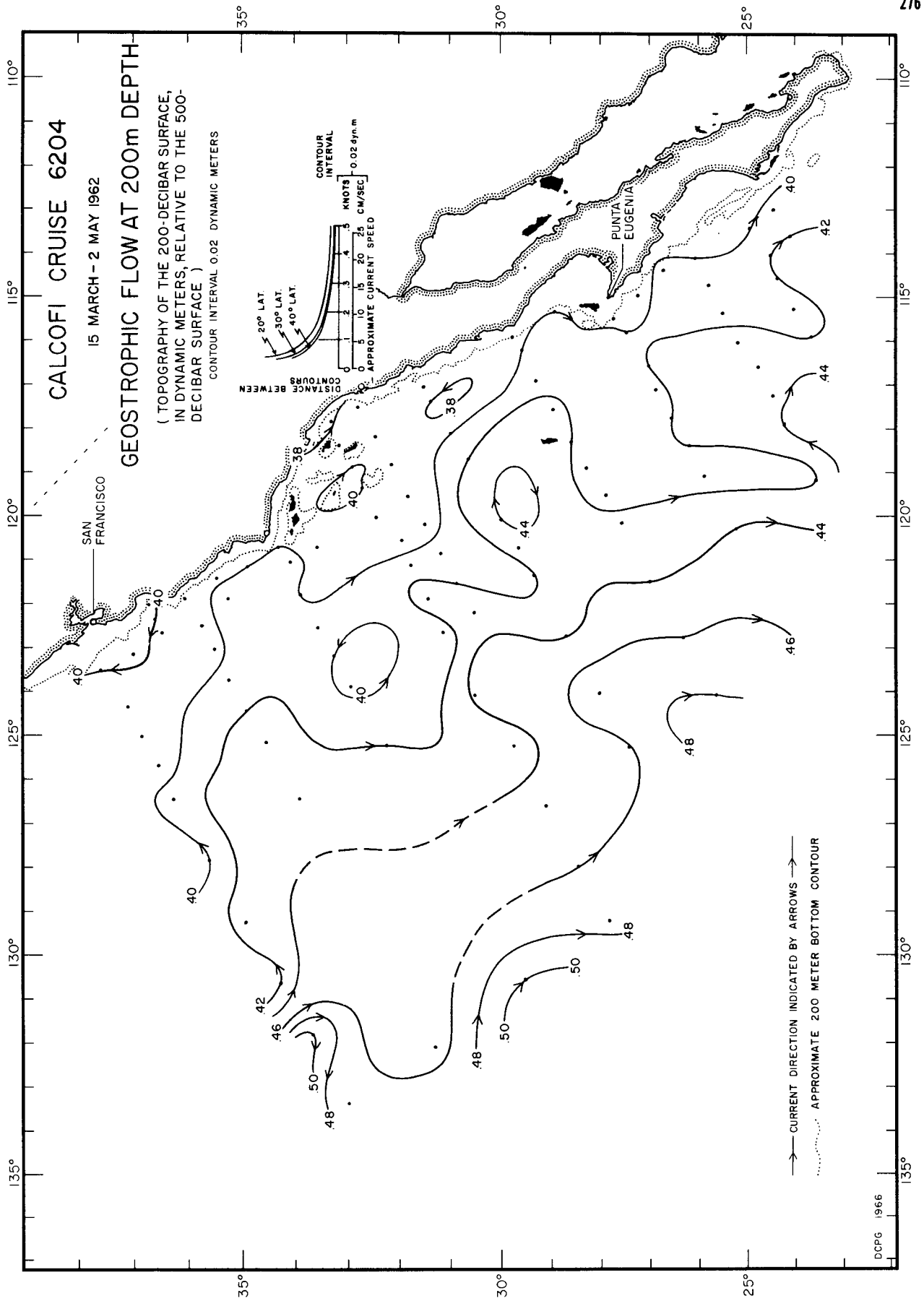


DCPG 1966

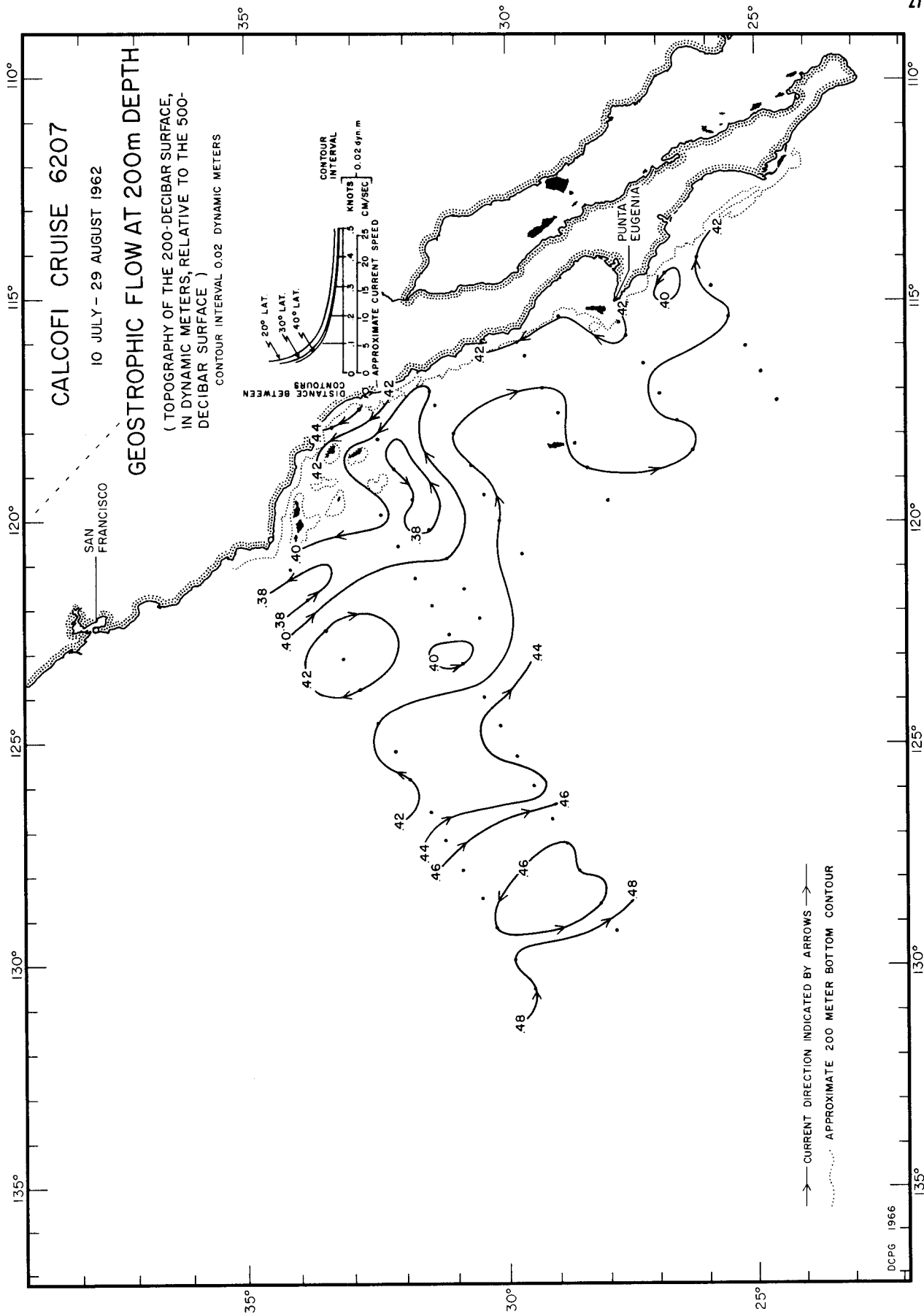


DCFG 1966

200/500 db  
6201



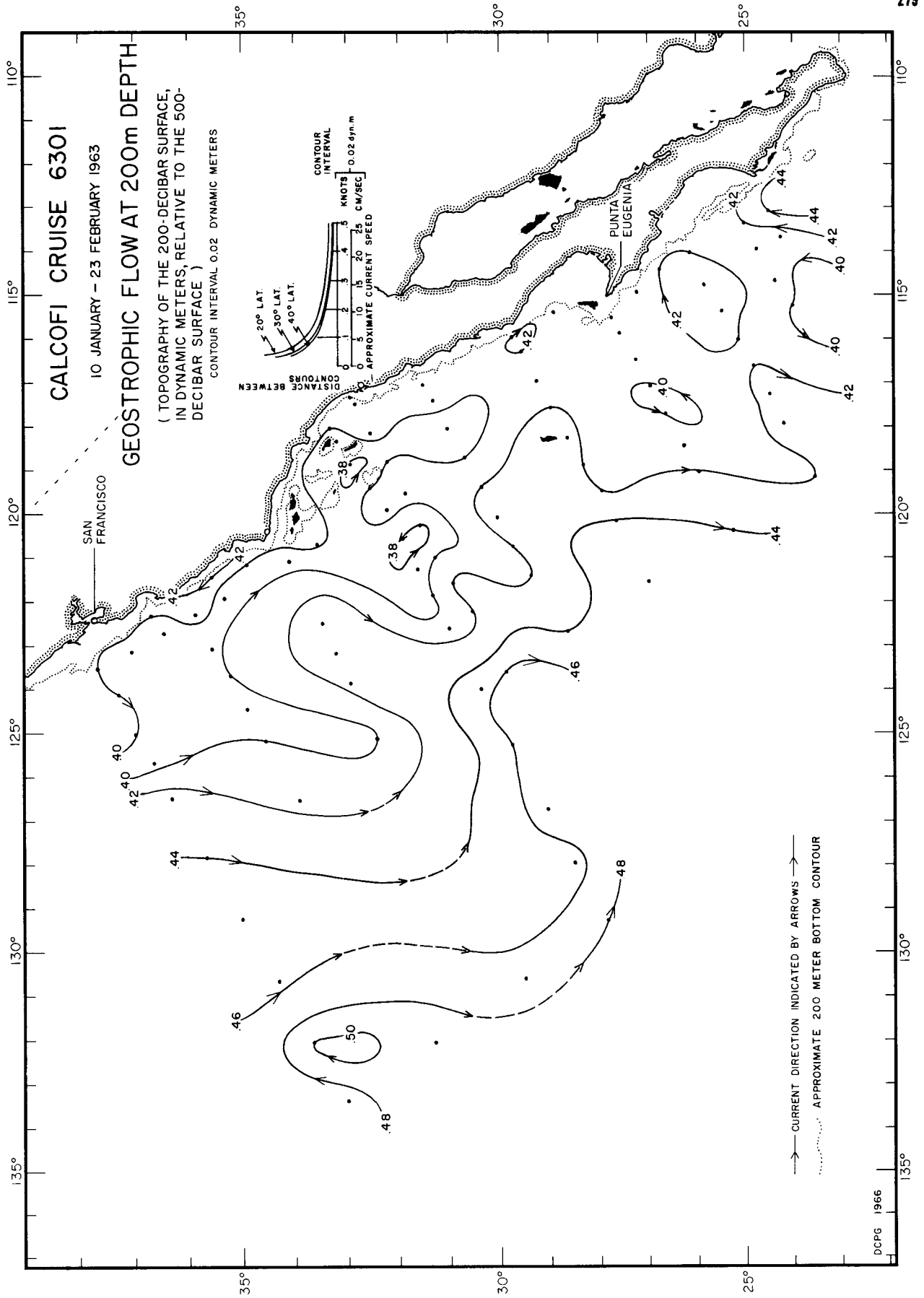
200/500 db  
 6204



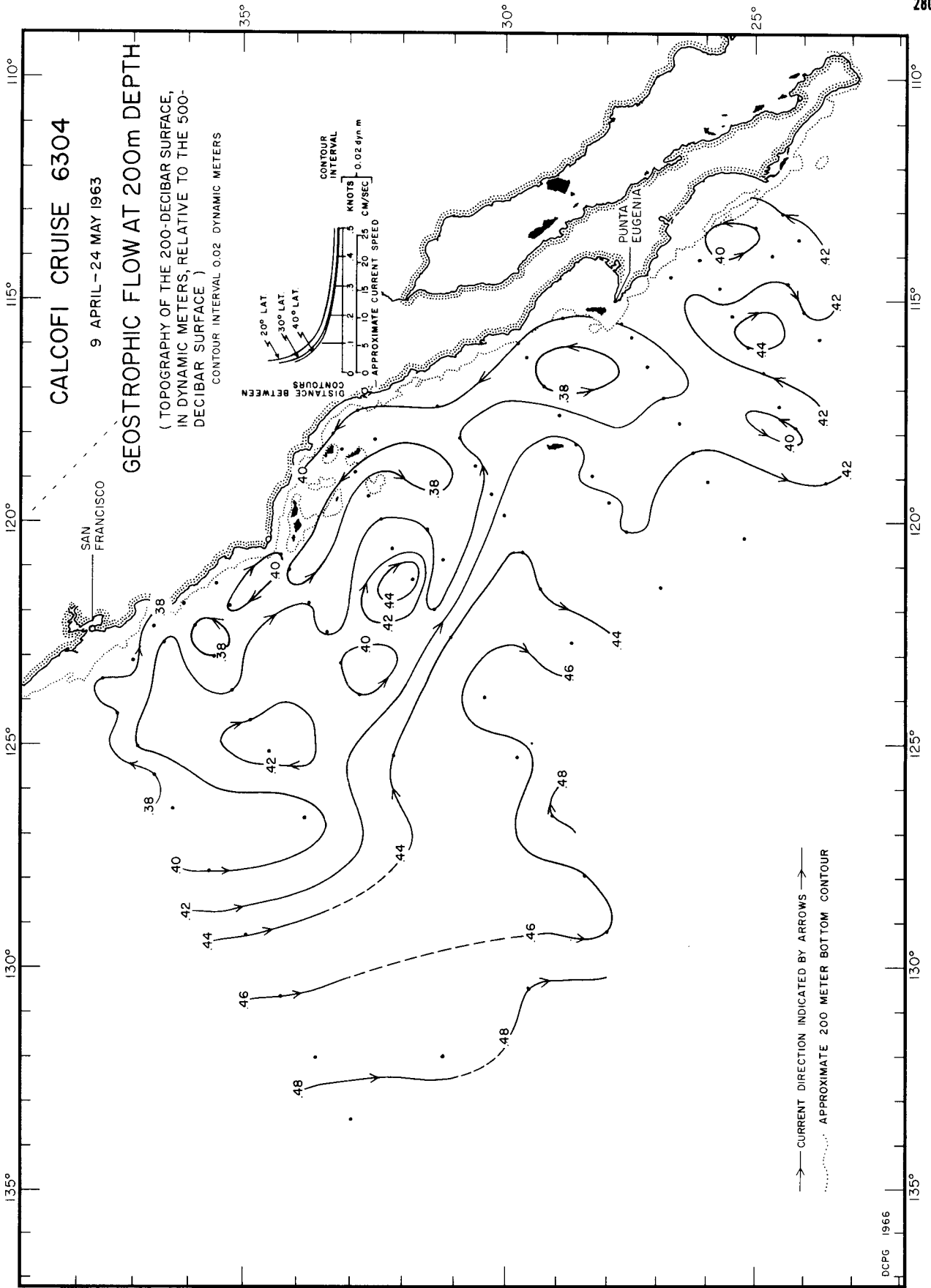
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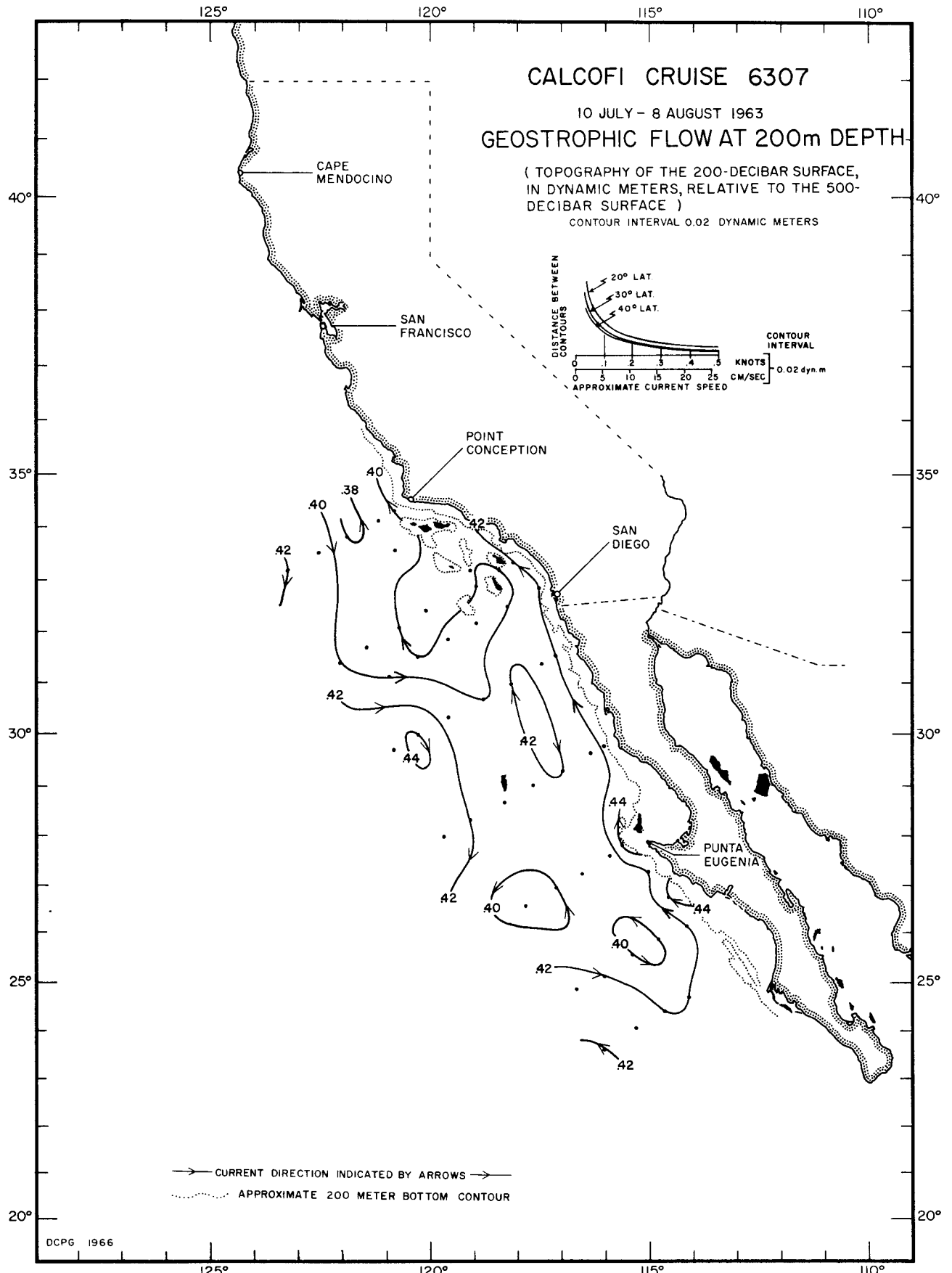


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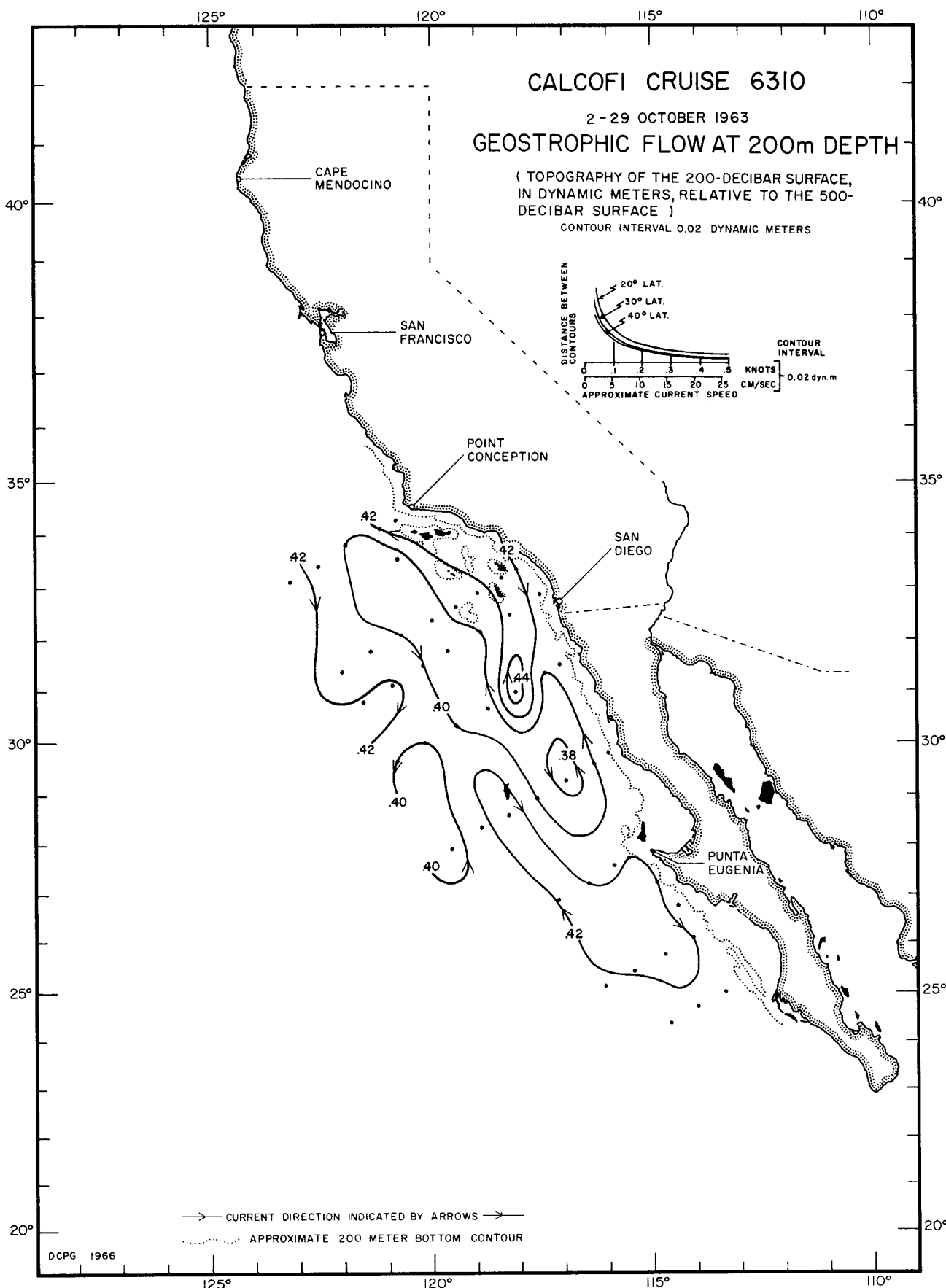


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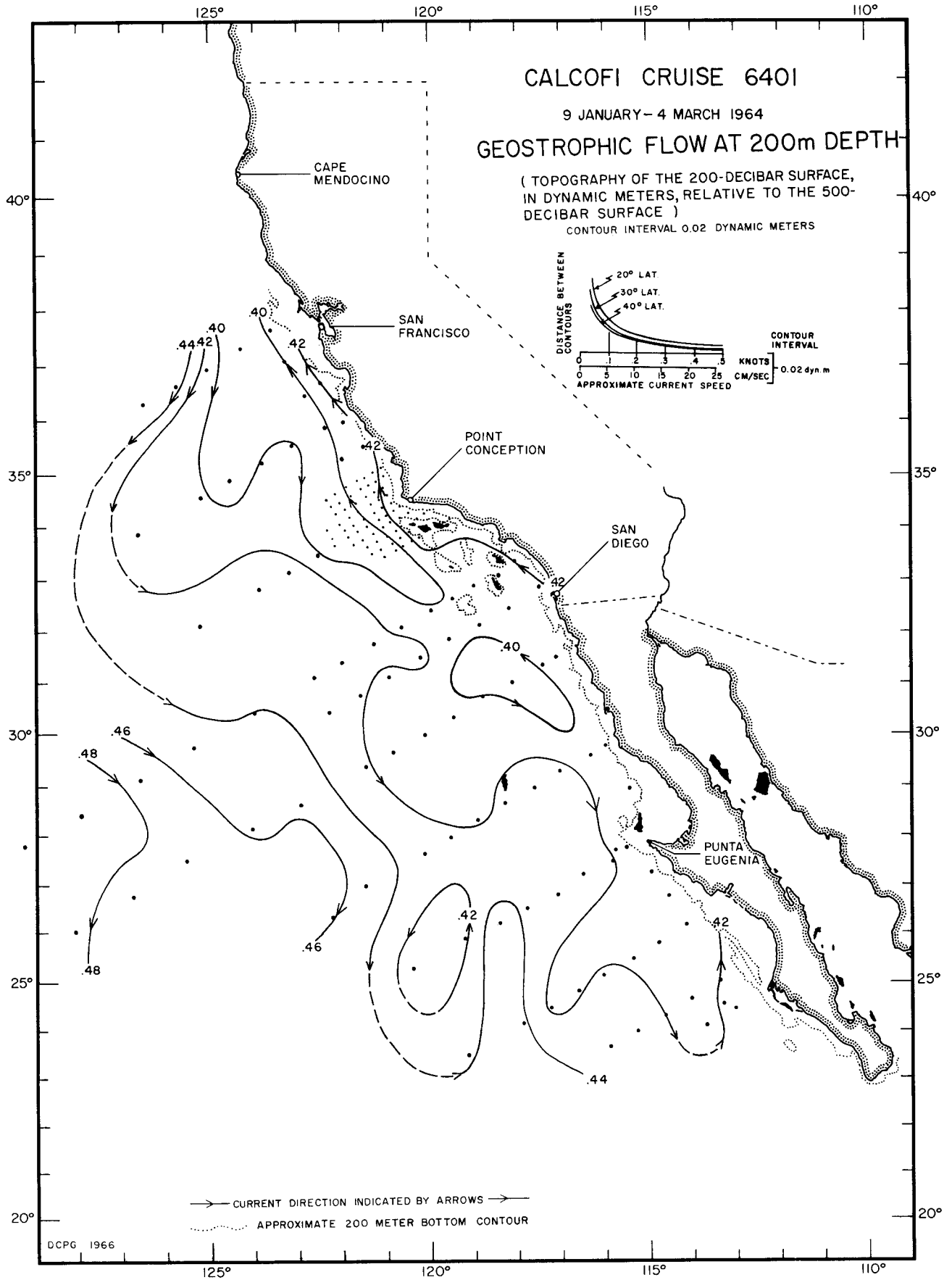
DCPG 1966



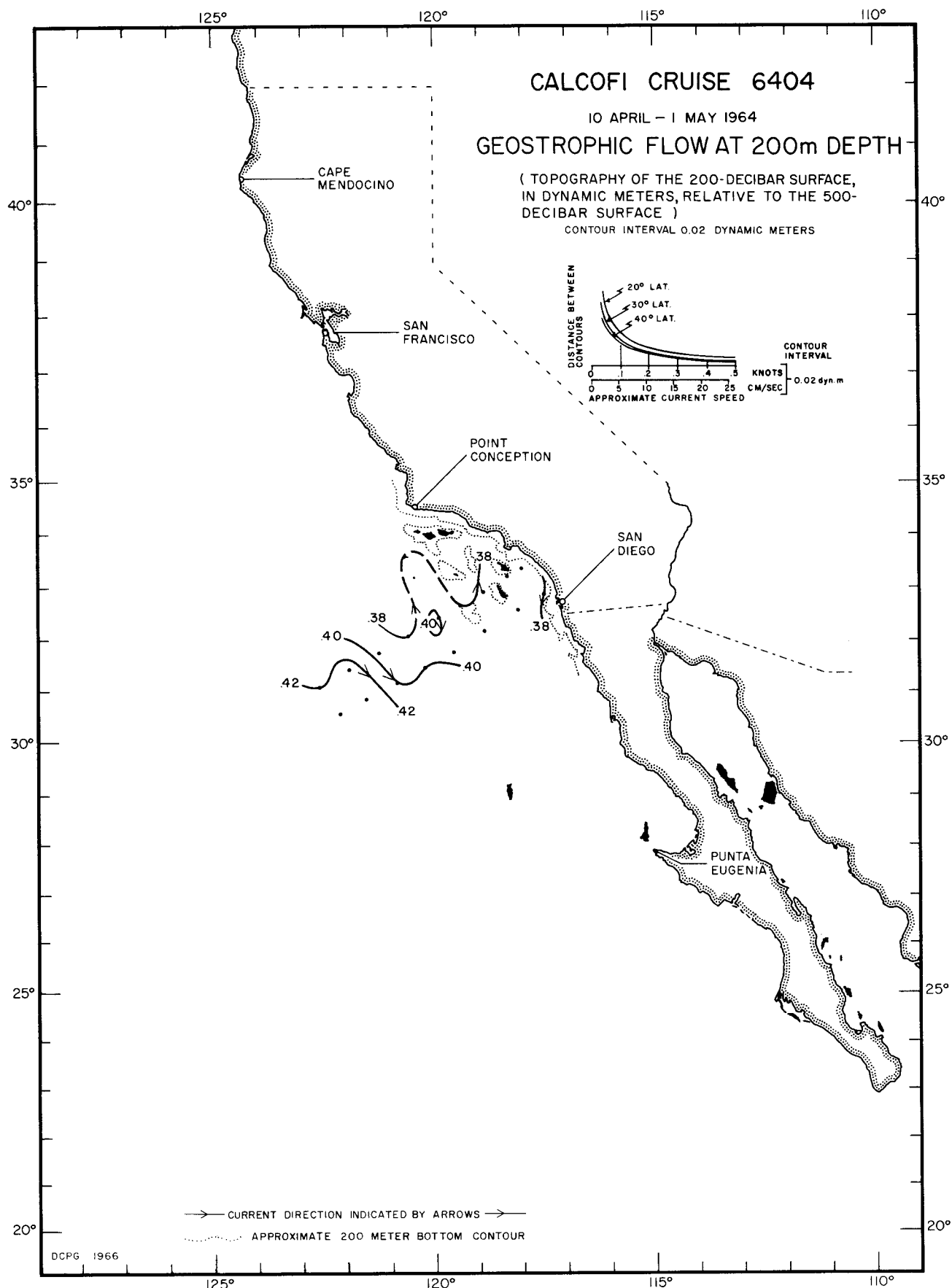
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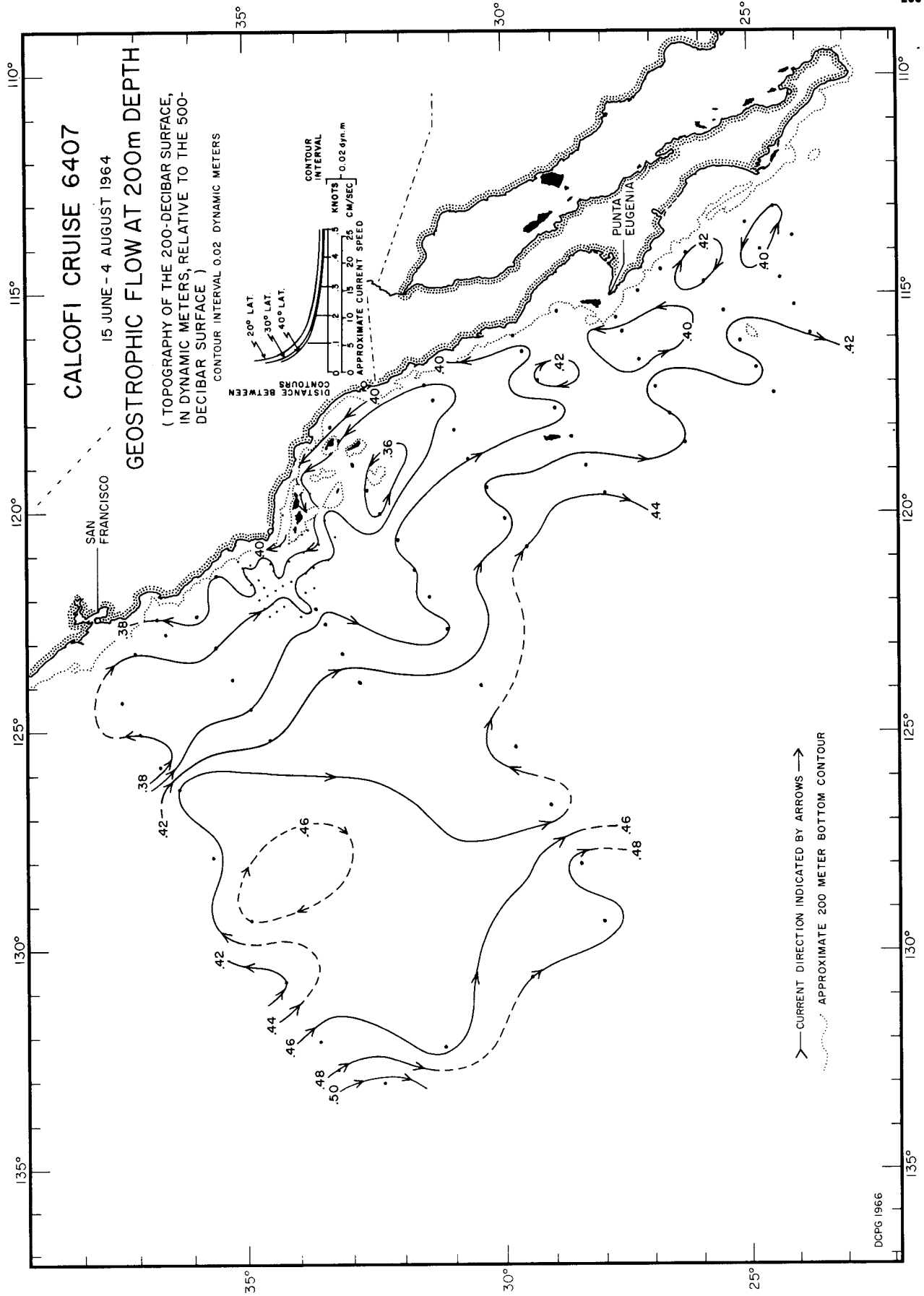
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6310



200/500 db  
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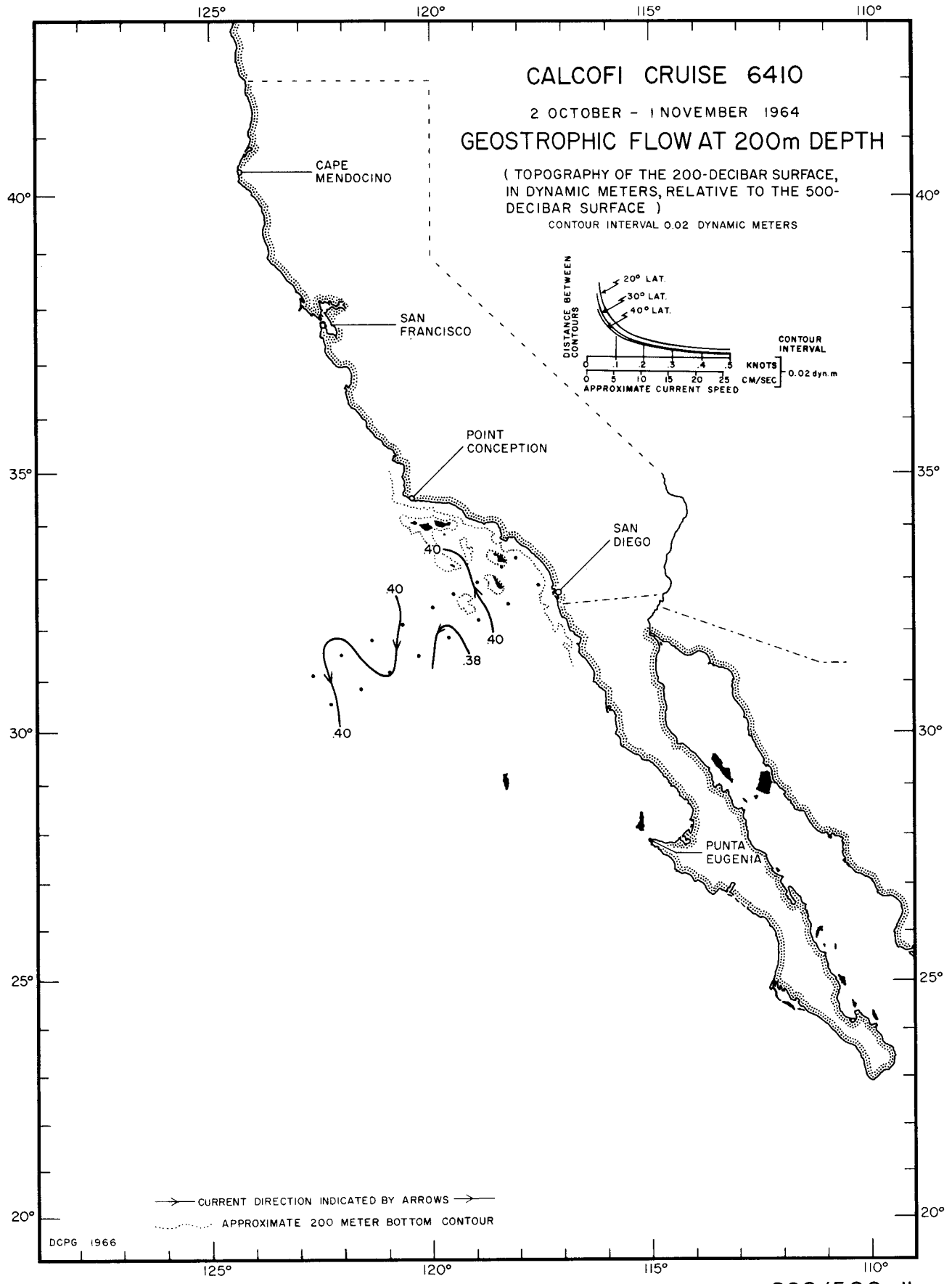
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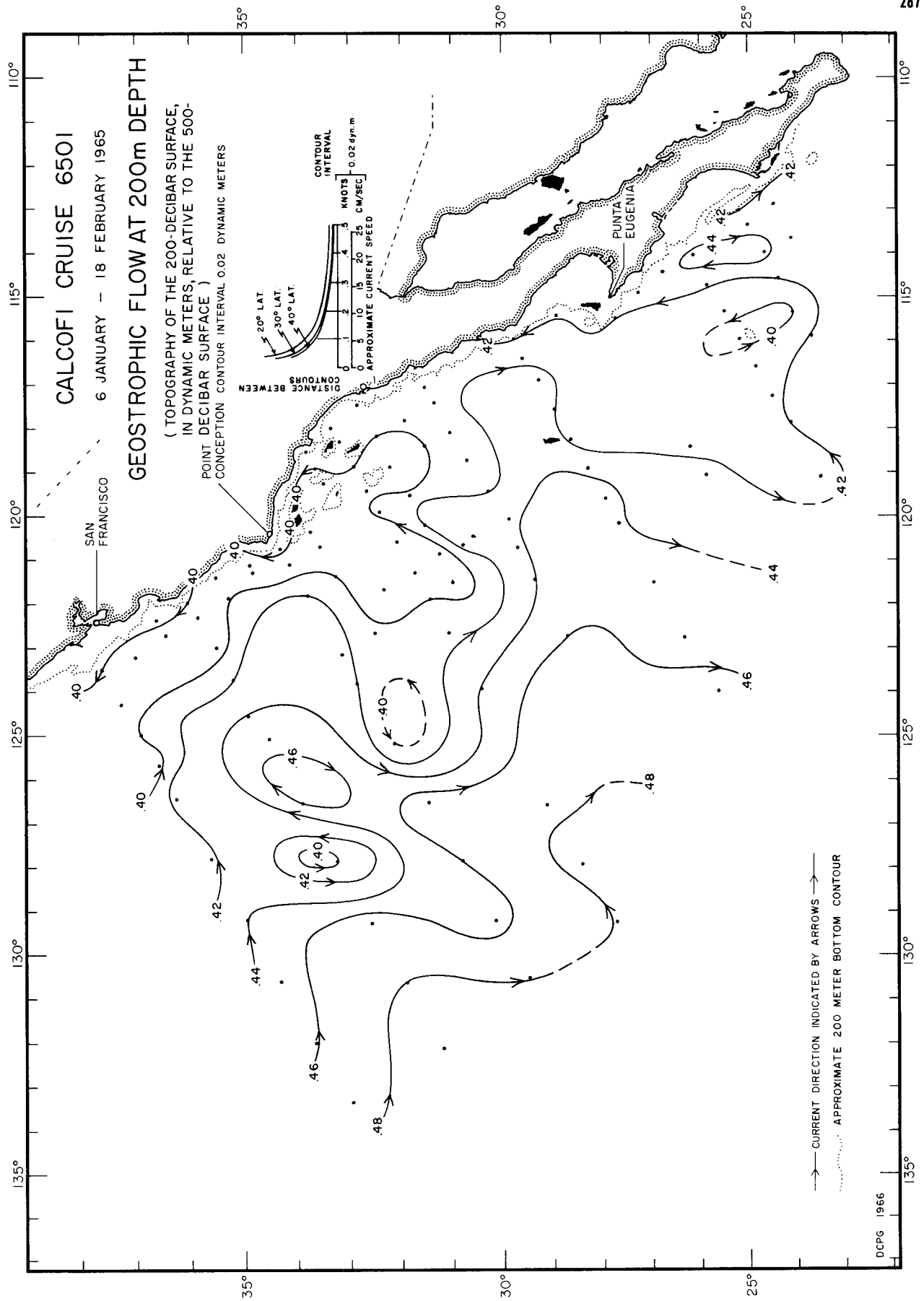
DCPG 1966

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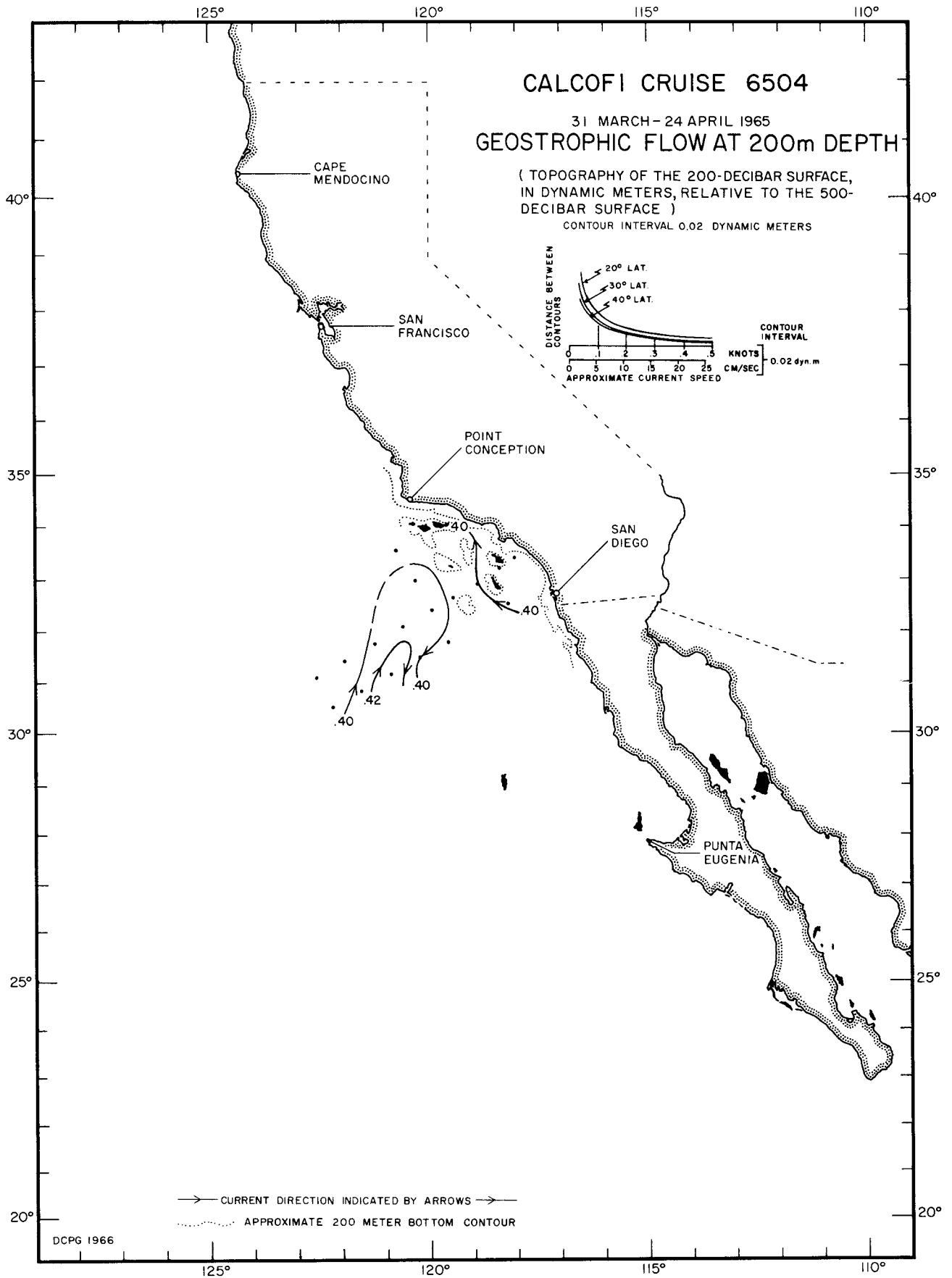


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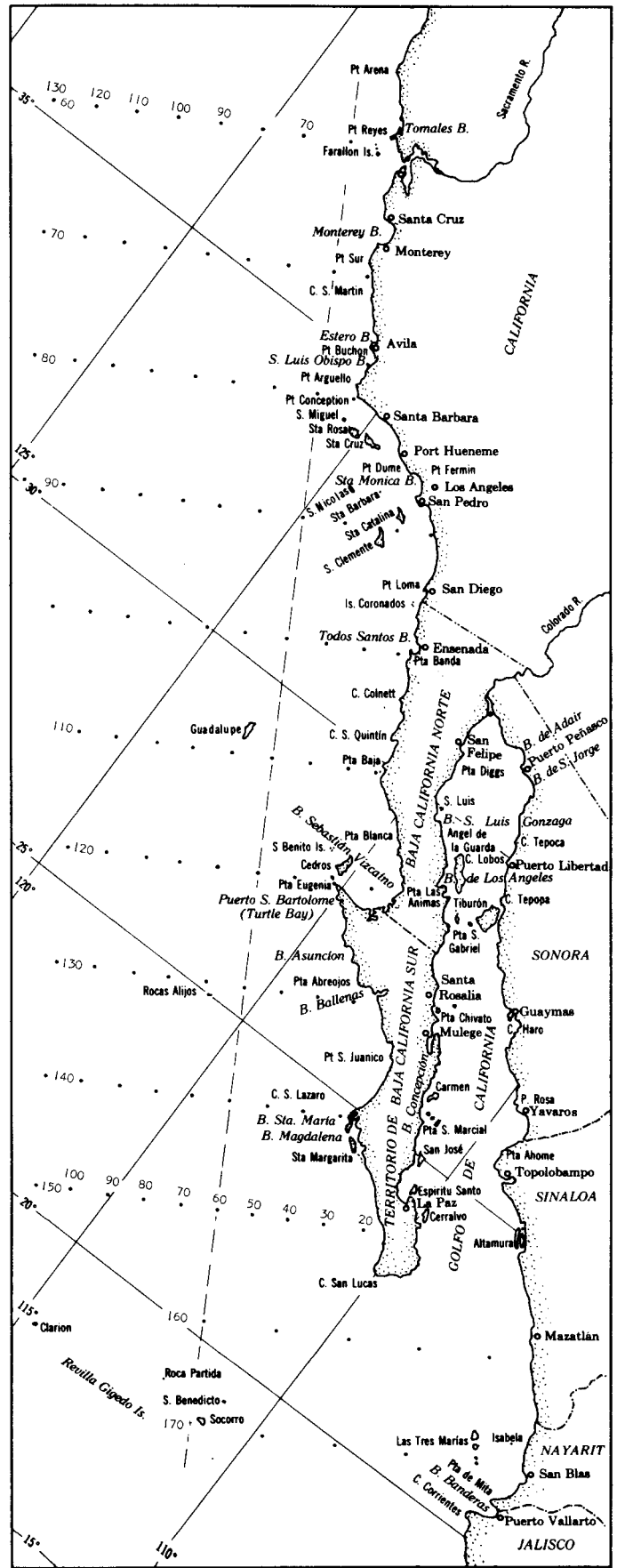
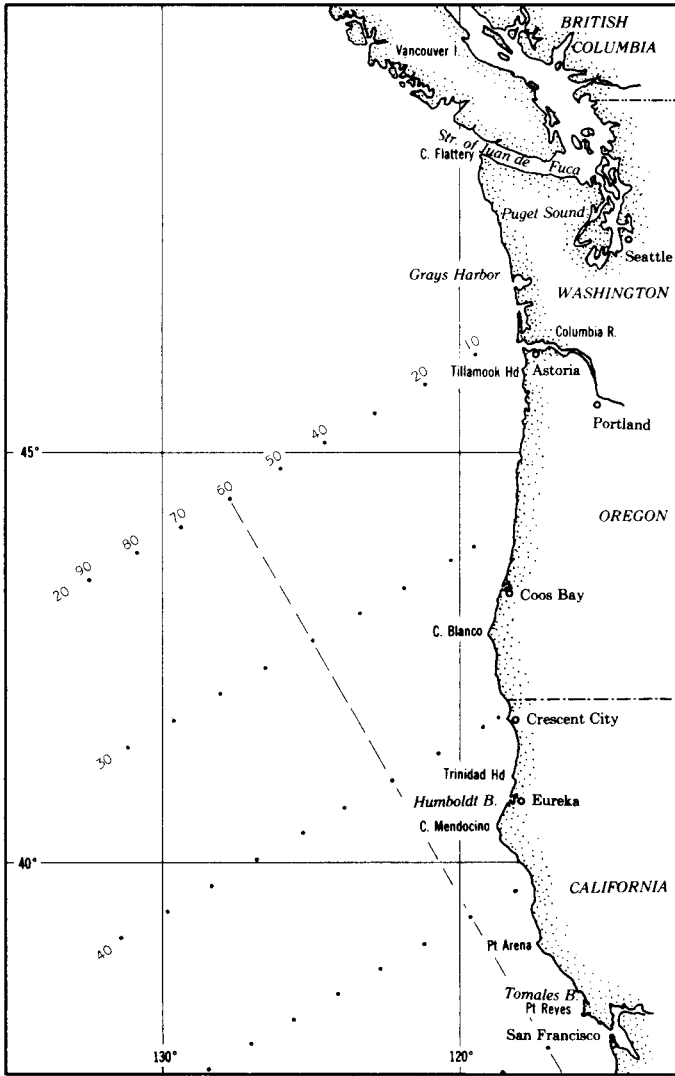
200/500 db  
6501

DCPG 1966



DCPG 1966

200/500 db  
6504



These maps are designed to show essential details of the area most intensively studied by the California Cooperative Oceanic Fisheries Investigations. This is approximately the same area as is shown in color on the front cover. Geographical place names are those most commonly used in the various publications emerging from the research. The cardinal station lines extending southwestward from the coast are shown. They are 120 miles apart. Additional lines are utilized as needed and can be as closely spaced as 12 miles apart and still have individual numbers. The stations along the lines are numbered with respect to the station 60 line, the numbers increasing to the west and decreasing to the east. Most of them are 40 miles apart, and are numbered in groups of 10. This permits adding stations as close as 4 miles apart as needed. An example of the usual identification is 120.65. This station is on line 120, 20 nautical miles southwest of station 60.

The projection of the front cover is Lambert's Azimuthal Equal Area Projection. The detail maps are a Mercator projection.

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