#92015

CRUISE REPORT, VERE92-2

Vessel:	R/V Vereshchagin
Cruise number:	VERE92-2
Parent project:	Global Change Stratigraphy
Area of operations:	Lake Baikal
Port:	Listvyanka, Siberia, USSR
Cruise dates:	July 21 - Aug. 1, 1992
Chief scientists:	S.M. Colman, U.S. Geological Survey E.B. Karabanov, Limnolog. Inst., Irkutsk
Cruise participants:	See attached list

Purpose of cruise:

This cruise was part of a long-term cooperative research program supported by the Siberian Branch of the Soviet Academy of Sciences, the U.S. Geological Survey, and the University of South Carolina. The overall objective of this program is to obtain and quantitatively interpret the sedimentary record of changing climate and limnology in Lake Baikal. Our approach is a large, multidisciplinary team effort of both field and laboratory work. Field operations involve the collection of high-resolution seismic-reflection data to delineate the sedimentary environments beneath the lake, to define how these environments have responded to climate change, and to locate and to correlate the best sites for coring. Seismic-reflection data also be critical to the selection of target sites for ice-based drilling operations planned to begin in 1992. Sediment cores provide the raw materials for analyses aimed at detailed reconstructions of paleoenvironmental conditions. Analytical studies include a multitude of micropaleontological, isotopic, geochronologic, sedimentological, and geochemical methods for reconstructing a detailed, quantitative Quaternary climate record.

This cruise follows a reconnaissance field effort in 1990 and a full-scale field program in 1991, which resulted in the collection of about 2500 km of high-resolution (3.5 kHz and water-gun) seismic reflection profiles and a set of piston, gravity, and box cores at 34 sites in Lake Baikal.

Navigation:

Positions were determined from GPS signals using a Magellan GPS receiver, and the BAMG PC-based software. Coordinates were recorded on disk at ten second intervals and were printed at 5 minute intervals using USGS navigation software. Coordinates were also recorded by hand in a navigation log book and on the seismic-reflection records.

Scientific equipment employed:

- Seismic reflection (3.5 kHz)
  - ORE 4-transducer towed fish
  - ORE 140 transceiver
  - EPC 4800 graphic recorder
- Seismic reflection (water gun)
  - SSI 15 in^3 water gun
  - Hydrophone streamer, 100 element
  - Amplifier/filter system
  - EPC 3200 graphic recorder
- Recording
  - HP 8-track analogue recorder
- Coring
  - WHOI 8-cm piston corer
  - Gravity corer (Russian)
  - Box corer (Russian)

Equipment performance:

The water-gun seismic system performed well, with no down time due to the gun or the streamer. The ORE 3.5 kHz system was plagued with a number of problems, including failure of some of the electronics and failure of two of the four transducers because the fish was dropped while being moved over the winter. However, eventually the system worked well as long as it operated in shallow water.

The GPS navigation system also worked well, with only occasional signal losses of short duration. The Branch navigation acquisition system was used for data logging, but scientists on board who were not familiar with the program (and some who were familiar with it) found it extremely difficult and unfriendly to use.

All of the coring systems worked well, with the exception that the small gravity corer was lost overboard, and the piston corer was unable to take four-barrel (40 foot) cores because the available core catchers were not stiff enough to retain the sediment. High-quality 8-9 meter cores were obtained using three barrels.

Cruise Operations:

Operations were focussed on two areas of the lake, the Selenga Delta and Academician Ridge, because previous our previous work had indicated that these areas contained the best potential sedimentary records of past climates in Siberia. In addition to Academician ridge, we collected data in the adjoining area of Maloye Marye. The particular part of the Selenga Delta that we focussed on was the pro-delta area of the saddle off Buguldeika.

Seismic-Reflection Profiling:
About 1100 km of seismic reflection profiles were collected during the cruise, mostly in two principle areas: the Selenga Delta-Buguldeika Saddle area and the Academician Ridge-Maloye Marye area. Two systems were used: (1) a very high resolution 3.5 kHz system, which gave about 0.5 m resolution and commonly gave 30-50 m of penetration into the sediments, and (2) a broad-band water-gun system (100-1060 Hz) that gave 1-2 m of resolution and as much as 300 m of penetration.

The overall quality of the seismic reflection data collected during the cruise was very good, although some trouble was experienced with the 3.5 kHz system in deep water (see above). Seismic profiles were invaluable for selecting core sites during the cruise, because of rapid lateral changes in sediment character and because of common disturbance of the sediments by faulting and erosion.

Coring Operations:
Piston, gravity, and box cores were collected at six different stations in the lake during the cruise. These included two gravity cores, six box cores, and 11 piston cores. Water samples were also collected at various depths at 2 stations and at the mouths of several rivers flowing into the lake. At most stations, two piston cores were collected. One was split, described, and sampled onboard ship; these cores will remain in Irkutsk for further analysis by Russian scientists. The second core from each station will be returned to the U.S. for analysis by U.S. scientists.

Subcores of box cores and selected piston cores were taken in order to 1) obtain samples of sediment pore waters and 2) obtain undisturbed sediment samples from the sediment-water interface for geochemical and electron-microscope analysis.

On-board analytical work

Core descriptions (Karabanov, Nelson, et al.):
One piston core, the related trigger core, and a subcore of the box core at each site were split onboard. Detailed description of each of these cores were completed on most of these cores, including 337-PC1, 337-PC2, 338-PC1 (0-150 cm), 339-PC1 (0-450 cm), 340-PC2, and 341-PC1. Smear slide samples were described for these cores, and they were subsampled for grain size, water content, and other analyses. All cores were photographed and videotaped.

Geochemistry (Granina, Seal, et al.):
Several geochemical tasks were performed during the cruise. The first comprised the collection of sedimentary pore waters, lake waters, and river waters for oxygen and hydrogen isotope analysis and for major and trace element geochemistry. Pore water samples were extracted from

piston and box cores from sites 337 and 340 by squeezing; several analytical determinations (pH, eH, alkalinity, and PO_4) were made on these samples during cruise. Altogether, more than 250 samples of pore, lake, and river water were prepared for further analysis.

The second task consisted of filtration of large (10-40 1) samples of lake and river water to obtain samples of suspended matter for radiocarbon and geochemical analyses. Several samples have been processed and several await future processing by Granina et al. Suspended sediment concentrations of the samples are mostly extremely low.

The third task was a feasibility study to examine the sulfur isotope chemistry of dissolved sulfate in the lake waters. Several large (10 1) water samples are being shipped to the U.S. for further processing and analysis.

Sediment magnetism (Peck):

Magnetic susceptibility was measured at 3 cm intervals on all cores (before they were split in the case of the Russian cores). The measurements were made using a Bardington MS2 meter and a 125 mm diameter susceptibility coil. Susceptibility values, which are primarily a measure of the concentration of magnetic materials, were edited and plotted for both piston cores at sites 339, 340, and 342. In addition to providing inferences about the origin and diagenesis of the sediments, the susceptibility measurements will be used in conjunction with physical descriptions, silica values, and other measurements, to correlated between multiple cores taken at each site.

Subsamples of the split cores (337-PC2, 339-PC1, and 340-PC2 so far) were also taken at 10 cm intervals in paleomagnetic sampling boxes. These samples, along with the USGS cores, will be measured for inclination, declination, intensity, ARM, IRM, and hysteresis parameters.

Problems encountered

In addition to the equipment problems described above, other major problems were encountered. First, because of budgetary problems, the Russian Academy of Sciences was unable to provide any of the support mandated by the memorandum of agreement concerning cooperative Russian-American research projects, except for providing the actual research vessel. We were required to pay almost all other transportation and logistical costs, including lodging, equipment (crane, truck, etc.), shipping, and personnel transportation.

Second, shipping of equipment and supplies was handled badly. The container shipment sent on April 15 arrived in Irkutsk only two days before we did. The air shipment, which contained the digital acquisition system for the cruise as well as a variety of critical spare components, arrived on the last day of the cruise, and was therefore of no use. Although it is not clear at present whose fault the shipping problems were, the chief scientists were not kept informed, and indeed were misinformed on most aspects of the shipping.

Finally, some of the equipment left in Listvyanka over the winter was missing. It is not clear whether this equipment was stolen or was mistakenly taken by other expeditions.

<u>Summary</u>

Although the cruise was plagued by logistical and equipment problems, the cruise was largely successful. The Vereshchagin performed well, all personnel remained healthy, and the weather cooperated. We now have (1) detailed seismic-stratigraphic data for the sedimentary environments in Lake Baikal that contain the best paleoclimate records, (2) long cores from each of these areas for analyses from which to reconstruct past climates and environmental conditions, and (3) sufficient stratigraphic and lithologic information from which to choose future drilling sites.

Attachments:
1. List of participants
2. List of cores
3. Track chart and core locations

cc:
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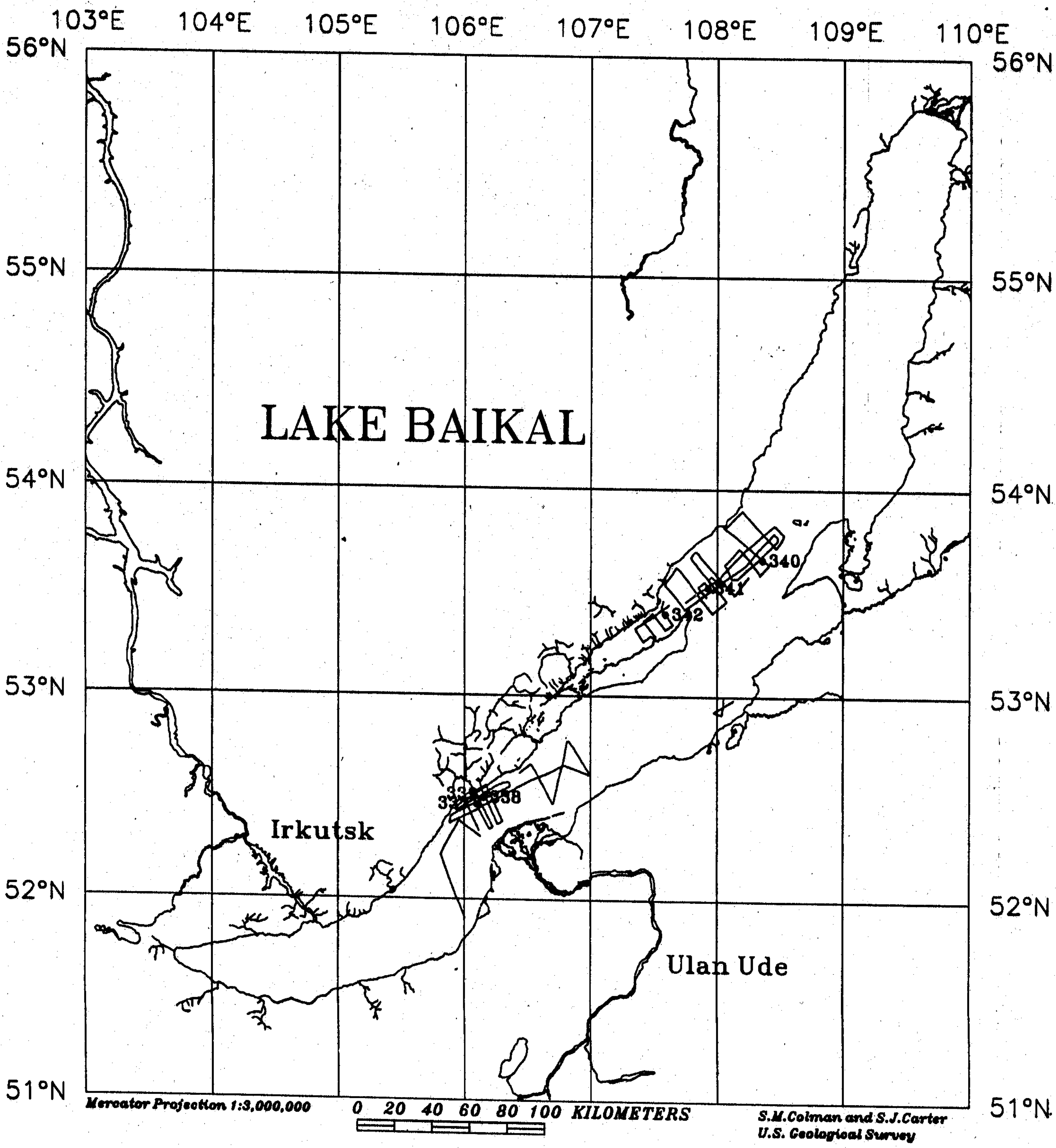
E. Kapnakova, Limnol. Inst.
P. Yermikova, Inst. Geog.-Cart.

LIST OF CORES

STATION	CORE	LATITUDE	LONGITUDE	WATER DEPTH	LENGTH (cm)	POSSESSION
337	BC1	52d28.39	106d06.88	400 m	41.5	subcores each
337	BC2	52 27.35	106 06.41	400	30	LI
337	PC1	52 28.27	106 05.89	400	508	LI
337	TW1	"	"	"	79.5	LI
337	PC2	52 27.50	106 06.62	370	816	half each
337	TW2	"	"	"	70	half each
337	PC3	52 28.21	106 07.39	390	927	LI
337	TW3	"	"	"	33.5	LI
338	BC1	52 30.33	106 09.21	375	38	subcores each
338	PC1	52 30.26	106 09.12	375	457	LI
338	TW1	"	"	"	75	LI
339	BC1	52 30.85	106 09.96	375	38	subcores each
339	GC1					LI
339	PC1	52 31.06	106 09.98	365	721	LI
339	TW1	"	"	"	41	LI
339	PC2	52 30.96	106 09.98	375	840	USGS
339	TW2	"	"	"	92	USGS
340	BC1	53 40.09	108 21.60	280	32	subcores each
340	GC1	53 40.00	108 21.49	280	46	LI
340	PC1	53 40.03	108 21.66	280	831.5	USGS
340	TW1	"	"	"	118	USGS
340	PC2	53 39.98	108 21.39	280	718.5	LI
340	TW2	"	"	"	125	LI
341	PC1	53 31.84	107 55.57	263	216	half each
341	TW1	"	"	"	25.5	half each
342	BC1	53 23.96	107 35.35	240	29	subcores each
342	PC1	53 23.96	107 35.29	240	888.5	USGS
342	TW1	"	"	"	60	USGS
342	PC2	53 23.89	107 35.34	240	909	LI
342	TW2	"	"	"	66	LI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U.S. Geological Survey

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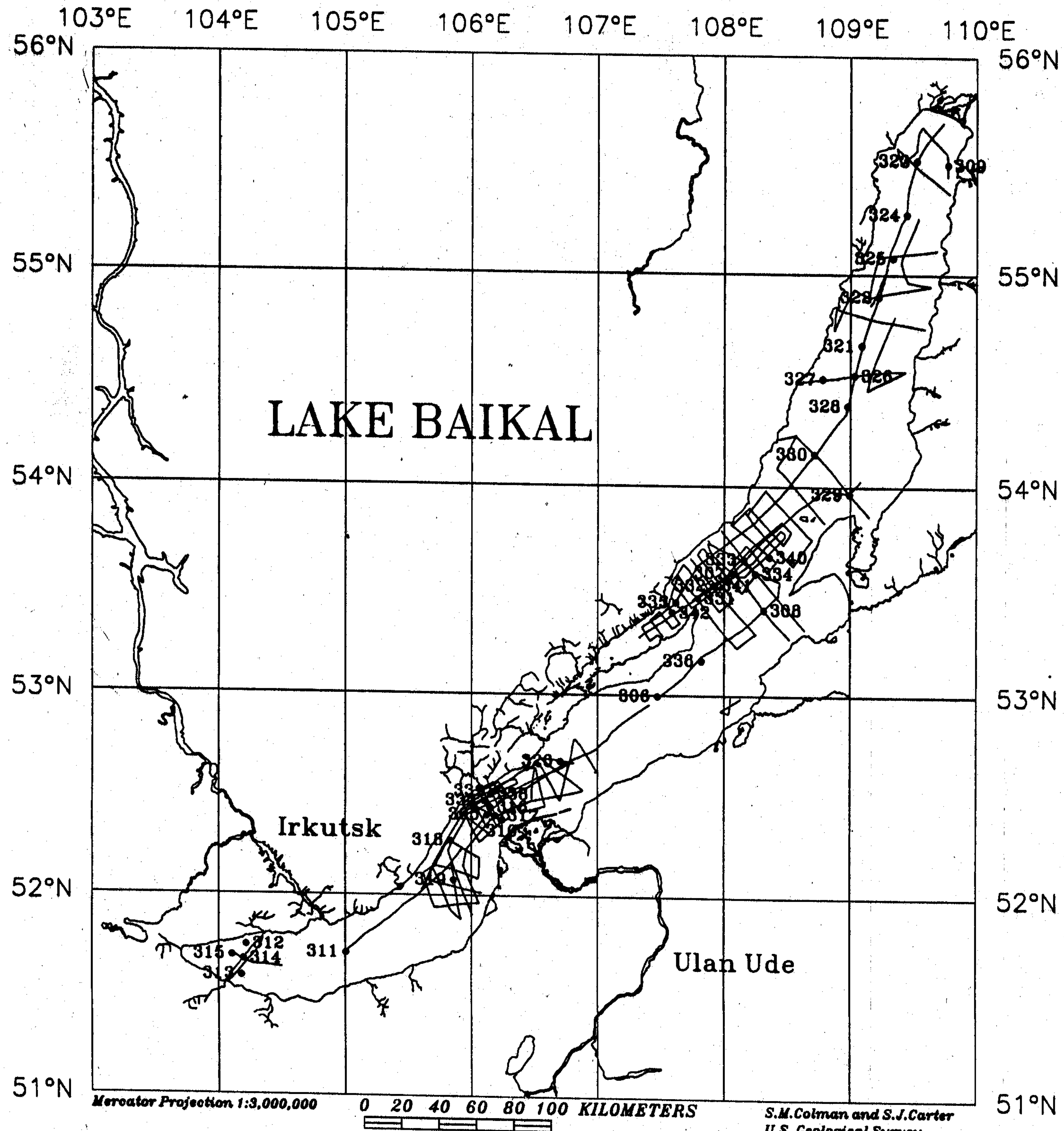

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