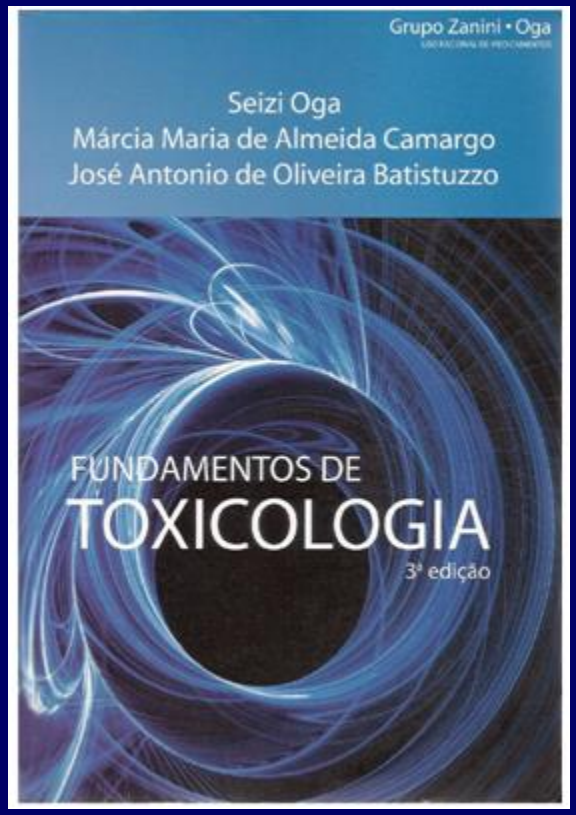
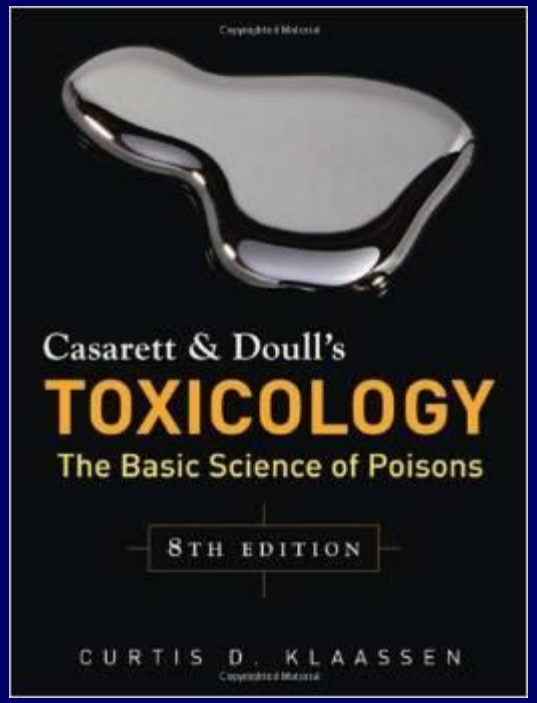
Disciplina: Toxicologia

Toxicologia Ocupacional

AULA 3

Prof. Fernando Barbosa





-Textos fornecidos aos alunos

Bibliografia

Elementos essenciais e tóxicos ao homem

H																He
Li	Be											**B**	C	N	O	**F**	Ne
Na	**Mg**											Al	**Si**	**P**	**S**	**Cl**	Ar
K	**Ca**	Sc	Ti	**V**	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**Zn**	**Ga**	Ge	**As**	**Se**	**Br**	Kr
Rb	**Sr**	Y	Zr	Nb	**Mo**	Tc	Ru	Rh	Pd	Ag	**Cd**	In	**Sn**	Sb	Te	**I**	Xe
Cs	Ba	57 a 71	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	89 a 103															

Maiores Essenciais				**Elementos-traço Essenciais**				**Elementos Tóxicos**

Principais fontes de exposição

(Pb) Fábricas de bateriais, tintas, pigmentos, cerâmicas, combustiveis

(Ag) Fotografias, equipamentos elétricos

(Hg) Amalgamas dentários, derivados de combustíveis fósseis lâmpadas fluorescentes, extração de ouro, produção de cloro, consumo de alimentos de origem marinha, peixes

(Tl) Semicondutores, lentes e componentes eletrônicos

(Mn) Atividades de mineração

(Cr) Pigmentos de tintas, eletrogalvanoplastia

(Pt) Catalizador em indústrias químicas

(Sn) Soldadores

(Cd) fumo, alimentos de origem marinha

ATSDR-Agency for Toxic Substances & Disease Registry

Classificação de 2019

Substância	Colocação
Arsênio	**1**
Chumbo	**2**
Mercúrio	**3**
Cloreto de vinila	**4**
Bifenilas policloradas	**5**
Benzeno	**6**
Cádmio	**7**
Benzo(a)pireno	**8**

Elementos essenciais e tóxicos ao homem

H																He
Li	Be											**B**	**C**	**N**	**O**	**F**	Ne
Na	**Mg**											Al	**Si**	**P**	**S**	**Cl**	Ar
K	**Ca**	Sc	Ti	**V**	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**Zn**	**Ga**	Ge	As	**Se**	**Br**	Kr
Rb	**Sr**	Y	Zr	Nb	**Mo**	Tc	Ru	Rh	Pd	Ag	**Cd**	In	**Sn**	Sb	Te	**I**	Xe
Cs	Ba	57 a 71	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	**Pb**	Bi	Po	At	Rn
Fr	Ra	89 a 103															

IVB

Maiores Essenciais				**Elementos-traço Essenciais**				**Elementos Tóxicos**

Vítimas do saturnismo

Deus saturno idolatrado na Roma Antiga

Exposição ao chumbo

Calígula e outros imperadores: vítimas históricas

Calígula

Portinari e Van Gogh

Beethoven

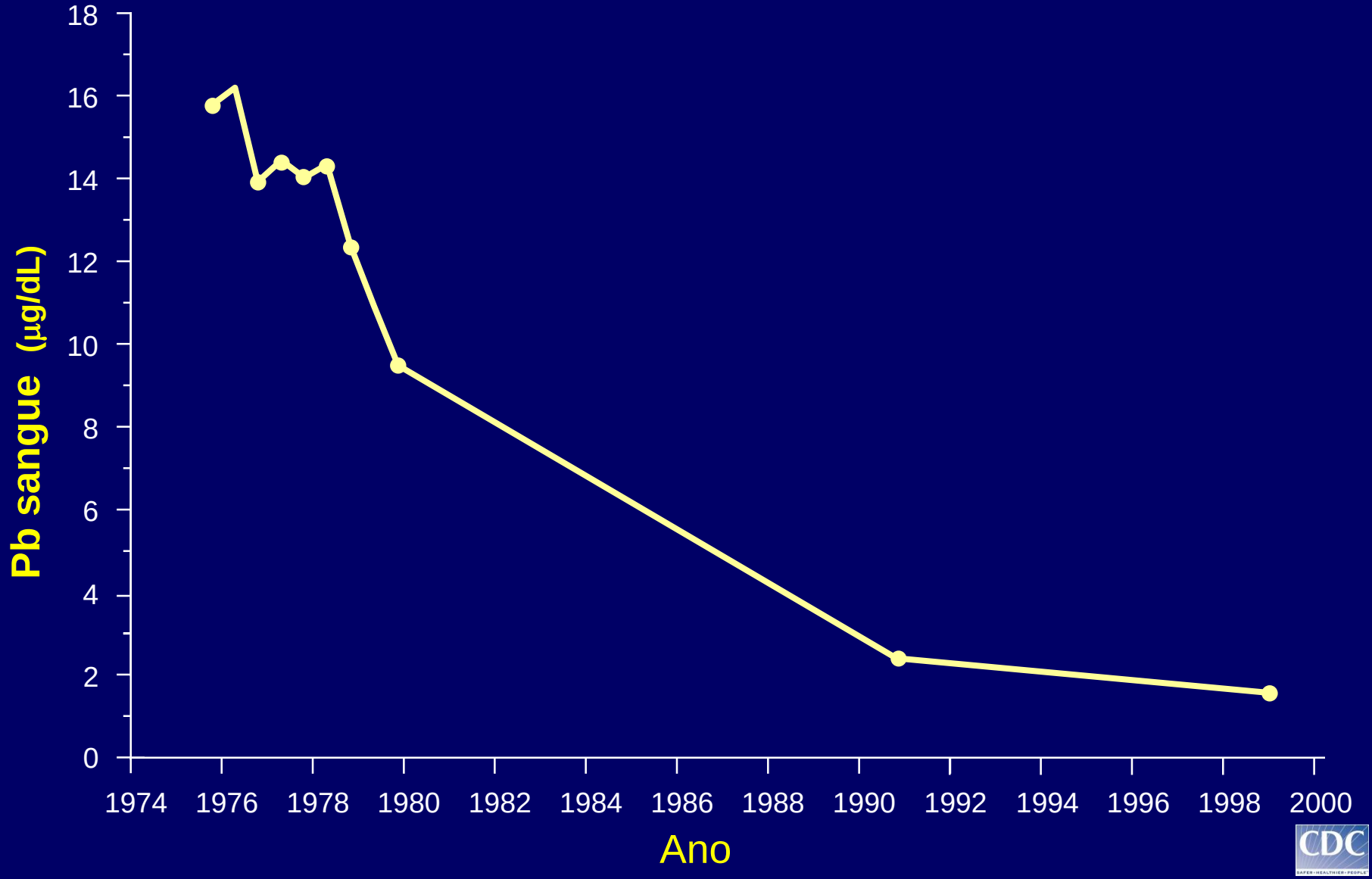
Chumbo (Pb)

Fontes de exposição

- Mineração - Fundição
- Metalurgia
  - Soldadores
- Fábricas de baterias
- Munição
- Tintas
- Vidraria
  - Pirex
  - Cristais
  - Tubos para TV e computador
- Cerâmicas

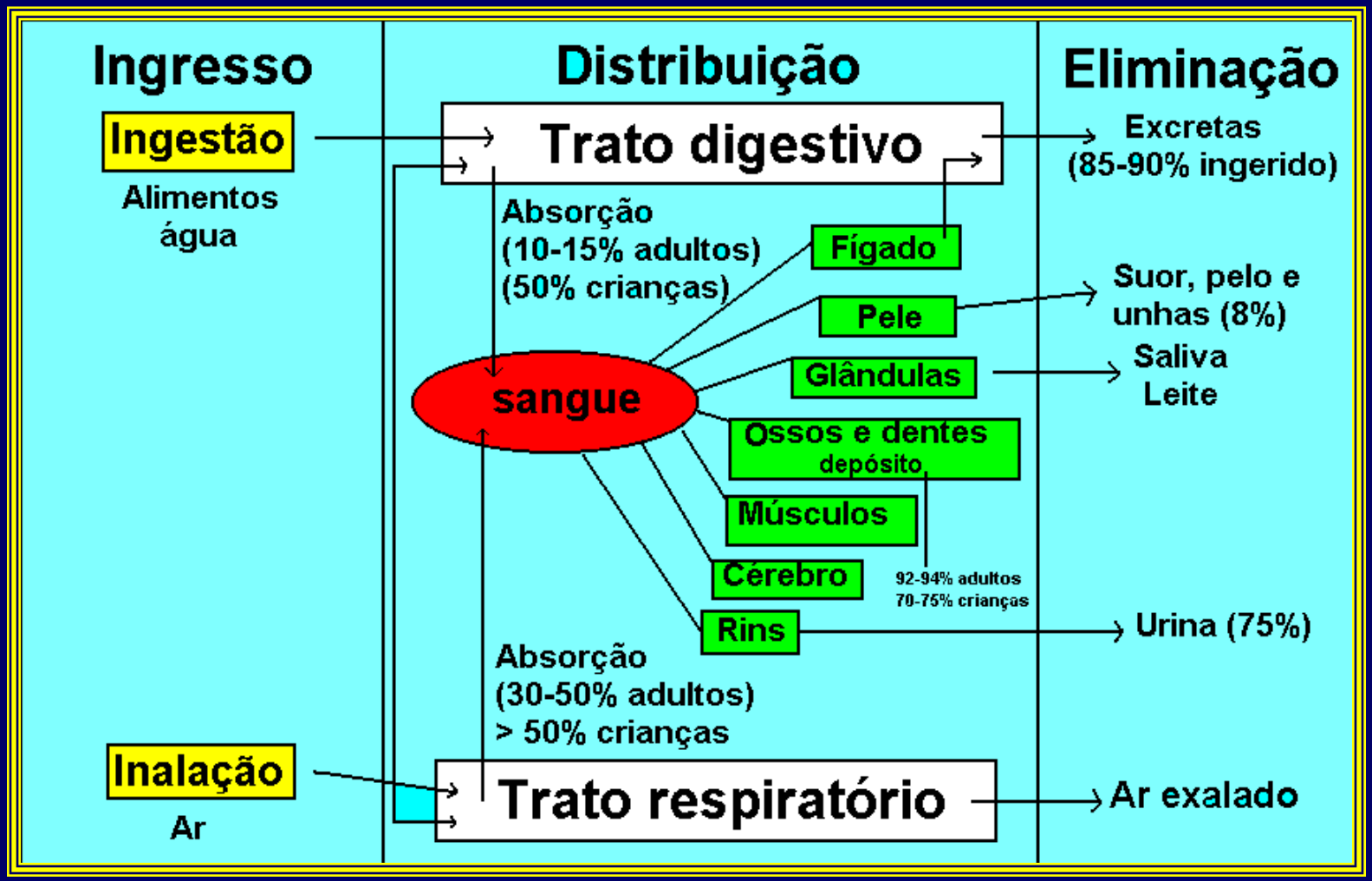
Níveis de Pb na população americana 1976 -1999

Exposição ambiental

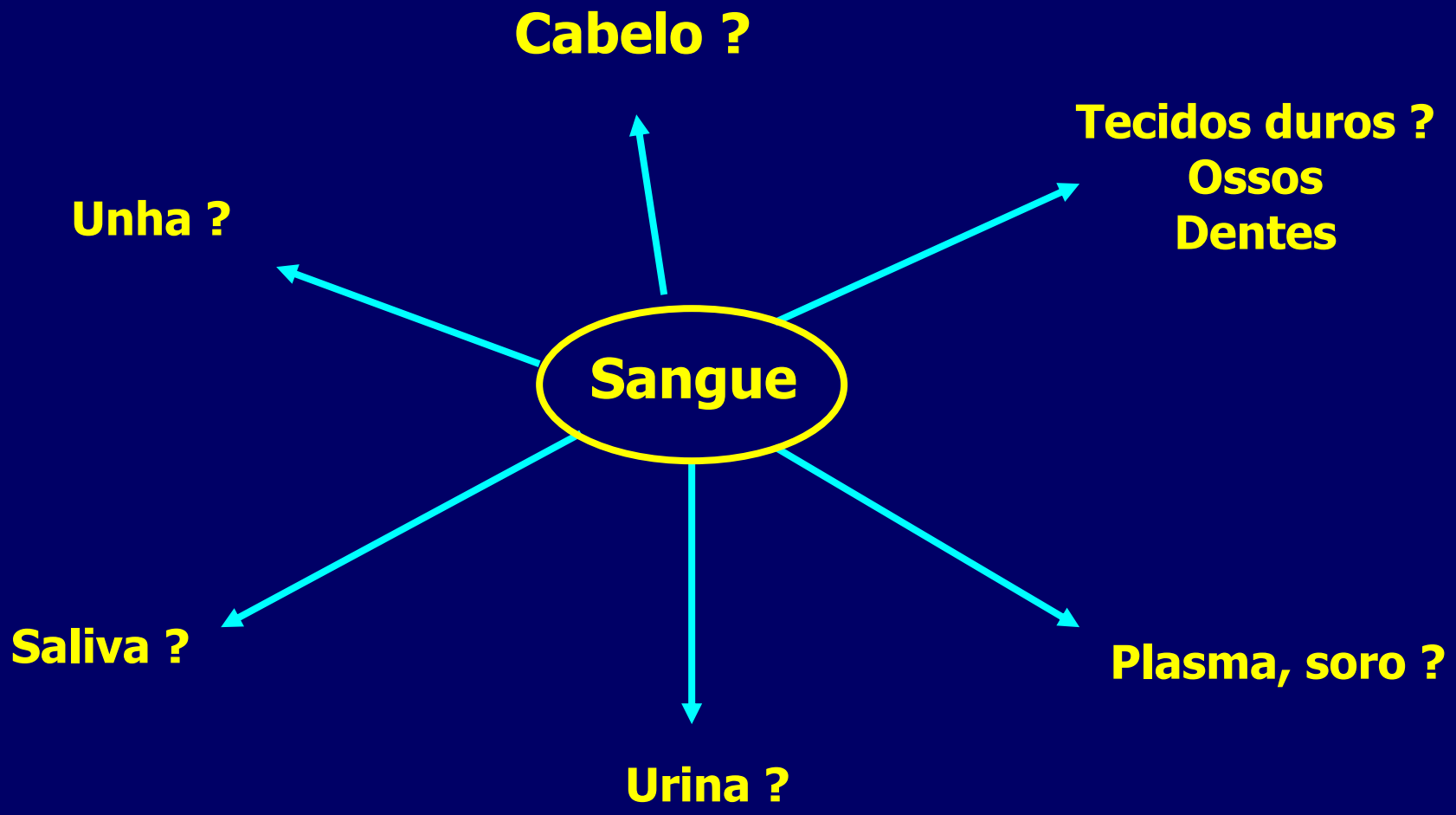


Toxicocinética do chumbo

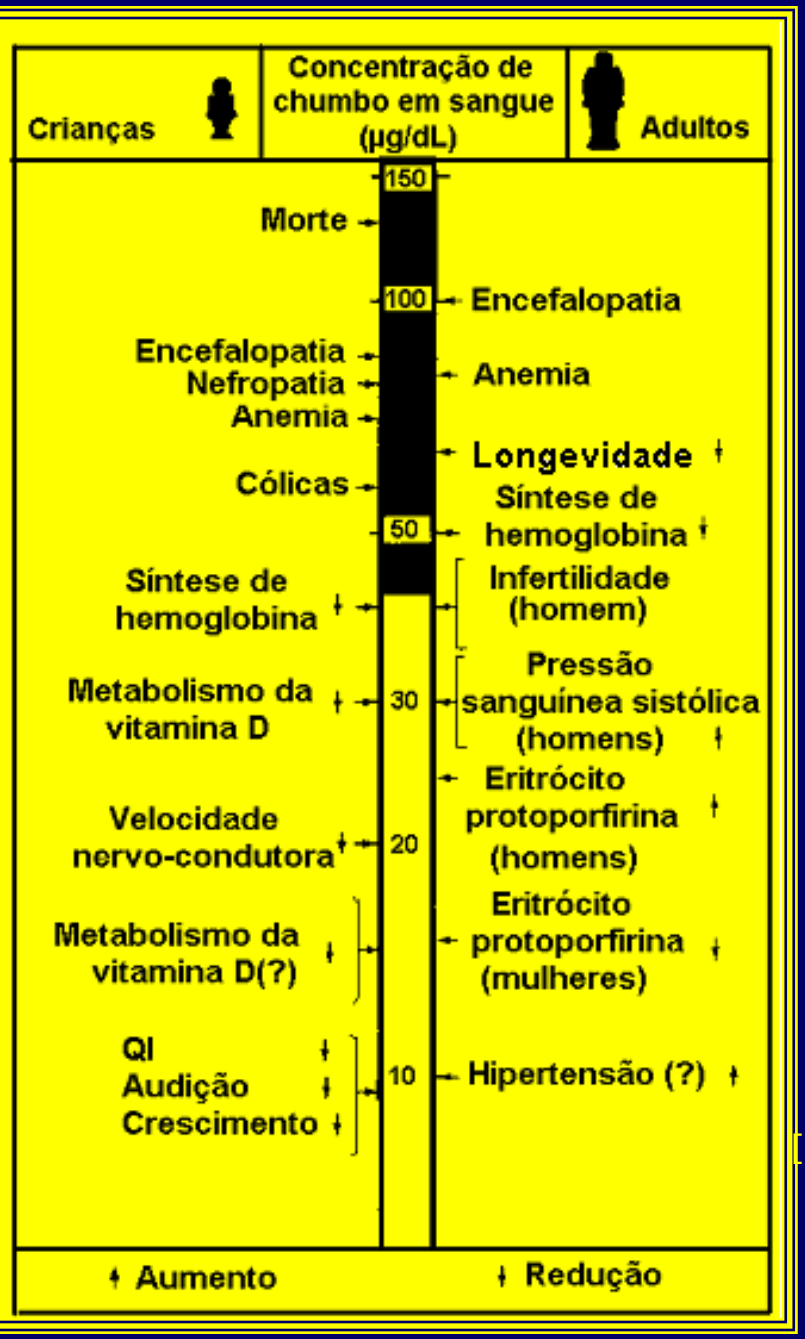
Adaptado de: Corey, G et al., Chumbo: Série Vigilância 8, *Organização Panamericana de Saúde (OPS)*, Washington, DC 1989.



Qual o melhor biomarcador de dose interna ao chumbo ?



Case Studies in Environmental Medicine:Lead Toxicity. US Public Health Service/ATSDR, 1990



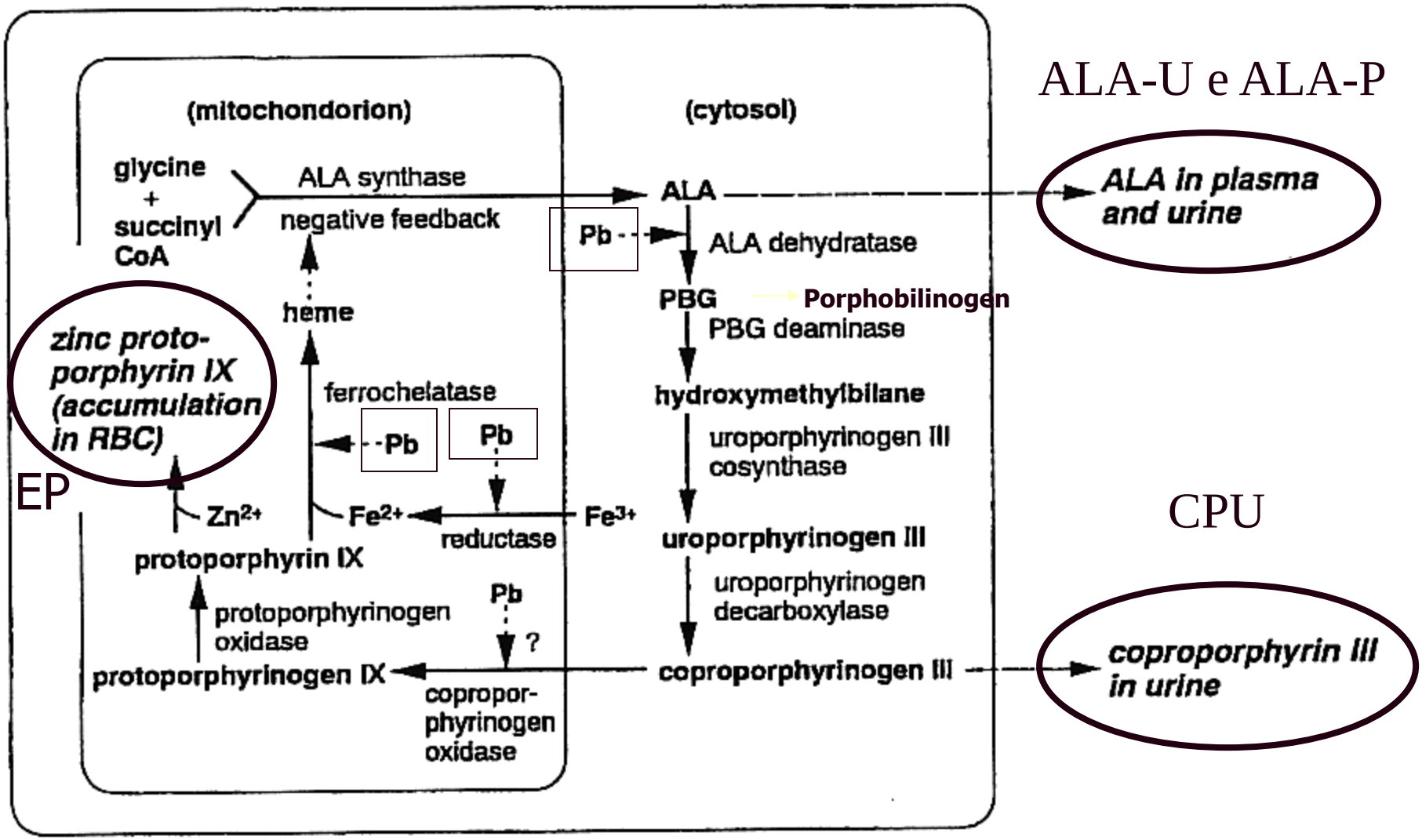
Toxicologia

Indicador biológico de exposição ao chumbo

Análise de sangue total

Preventing lead poisoning
[Report], U.S. Department of Health and Human Services, Atlanta, GA, 1991

Chumbo e biosíntese de heme



Relação entre chumbo no sangue e biomarcadores de efeito

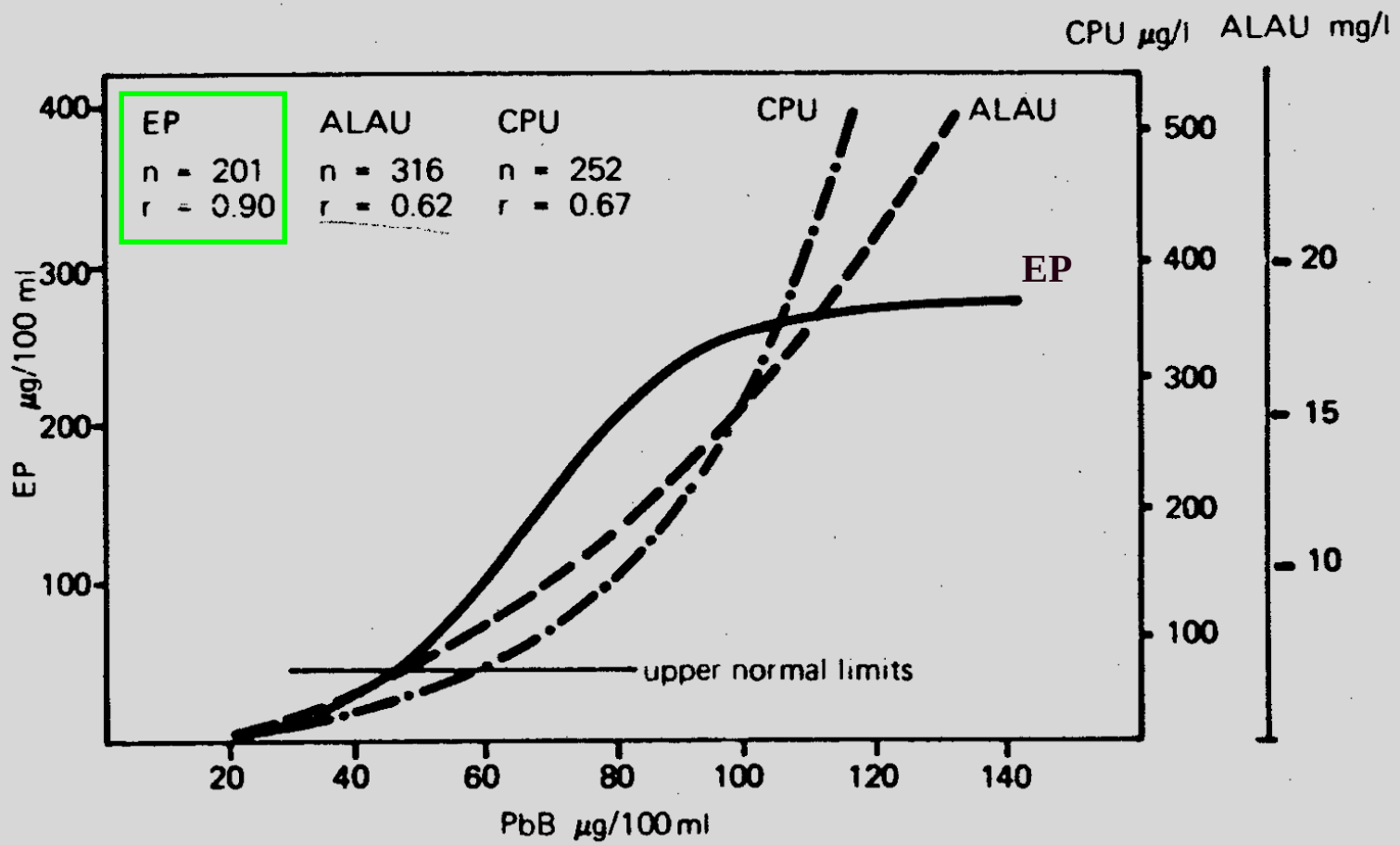


Figure 9 - Relationship between PbB and indicators of effect in adult males currently exposed to lead

Elementos essenciais e tóxicos ao homem

H																He
Li	Be											**B**	**C**	**N**	**O**	**F**	Ne
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Rb	**Sr**	Y	Zr	Nb	**Mo**	Tc	Ru	Rh	Pd	Ag	**Cd**	In	**Sn**	Sb	Te	**I**	Xe
Cs	Ba	57 a 71	Hf	Ta	W	Re	Os	Ir	Pt	Au	**Hg**	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	89 a 103									**IIB**						

Maiores Essenciais				**Elementos-traço Essenciais**			**Elementos Tóxicos**	

Hg

Formas químicas, fontes de exposição e efeitos tóxicos

Chapeleiro maluco
(1865)

FORMAS	FONTES	EFEITOS
Hg(0)	• Ocupacional, amálgamas dentários, termômetros, lâmpadas fluorescentes;	Danos ao sistema nervoso Danos renais Danos sistema reprodutor Danos Cardiovasculares (Hipertensão)
Hg(II)	• Ocupacional, Cremes pele, alimentos.	
MeHg	• Alimentos de origem marinha, peixes;	Mercurialismo
EtHg	• Antissépticos, vacinas.	

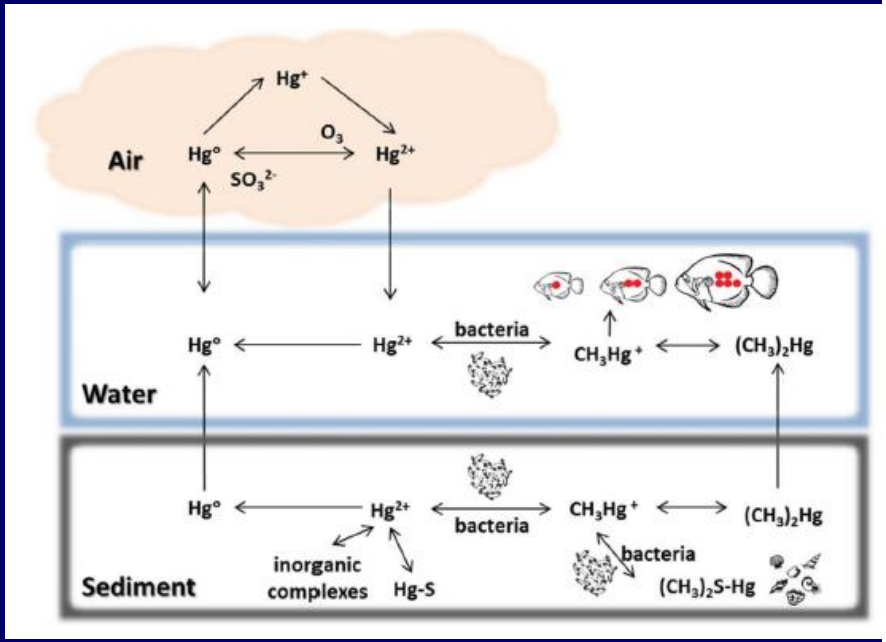
Arsenic, cadmium, and mercury-induced hypertension: mechanisms and epidemiological findings

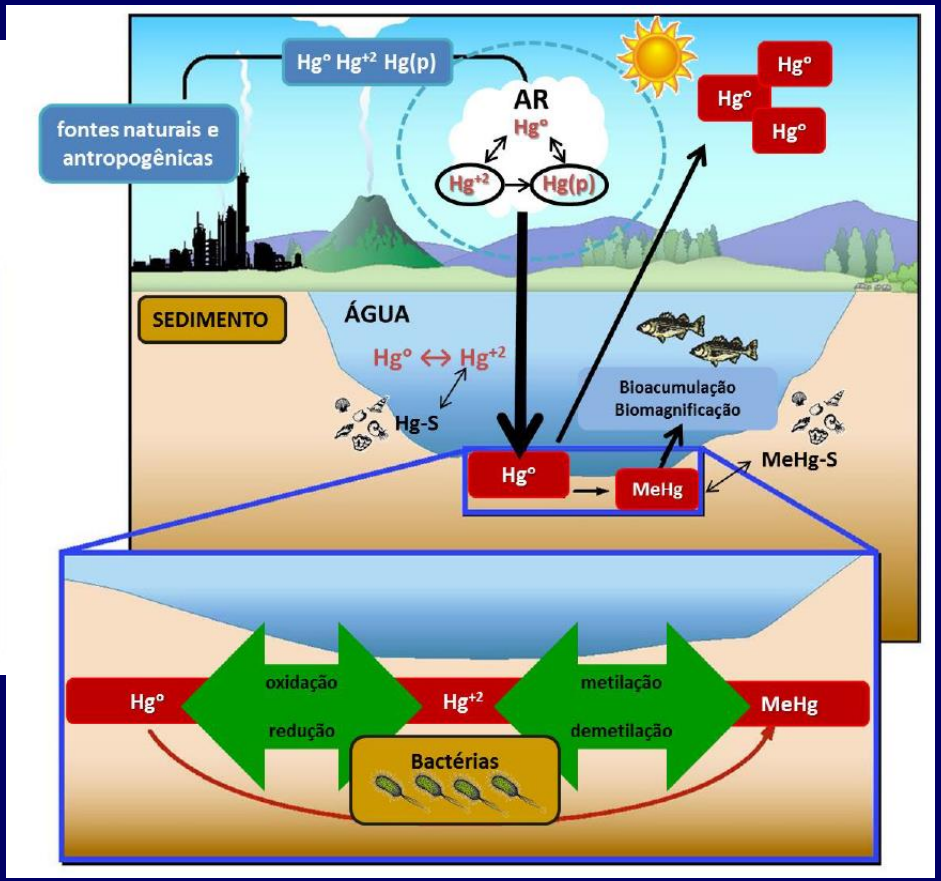
Airton da Cunha Martins Jr[a], Maria Fernanda Hornos Carneiro[a], Denise Grotto[b], Joseph A Adeyemi[a], and Fernando Barbosa Jr.[a]

JOURNAL OF TOXICOLOGY AND ENVIRONMENTAL HEALTH, PART B
https://doi.org/10.1080/10937404.2018.1432025

ATSDR, toxicological profiles for Hg, 1999

Ciclo do Hg no ambiente





Toxicological & Environmental Chemistry, 2014
Vol. 95, No. 8, 1424–1447, http://dx.doi.org/10.1080/02772248.2013.877246
Taylor & Francis
Taylor & Francis Group

Maria Fernanda Hornos Carneiro[a,b], Christudas Morais[a], Fernando Barbosa Jr[b] and Glenda Carolyn Gobe[a]*

Intoxicação por Hg

Local	Ano	Casos	Motivo	Forma (Hg)
Minamata	1953-60	> 2.500	Chisso Corporation	MeHg
Nigata	1964-65	646	Petroquímica Showa Denko	MeHg
Iraque	1956-1971	> 50.000	Semente de trigo contaminada	MeHg

Amazônia Brasileira

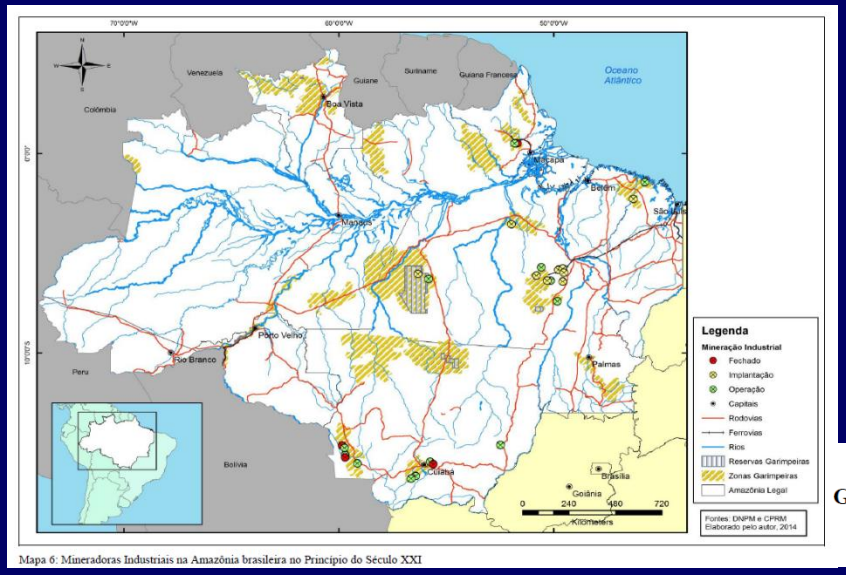
Mercury Contamination in the Amazon: A Gold Rush Consequence

AMBIO VOL. 17 NO. 4, 1988

Report

By Luiz A. Martinelli, Jose R. Ferreira, Bruce R. Forsberg and Reynaldo L. Victoria

This paper presents the results of mercury analyses on fish, plants and sediments, collected along the Madeira River (Amazon Basin) in January 1986. Mercury levels in muscle and eggs from detritivorous, herbivorous, carnivorous, and omnivorous fish ranged from 0.04–3.81 $\mu g\ Hg \cdot g^{-1}$. Several of these values exceeded the safety limit established by the World Health Organization. Mercury concentrations in suspended river sediments, river bedload and floodplain (varzea) sediments ranged from 0.01–0.2 $\mu g\ Hg \cdot g^{-1}$, with little difference between sediment types or among samples collected at different points downstream from Porto Velho. The highest plant values, 0.91 and 1.04 $\mu g\ Hg \cdot g^{-1}$, were obtained for *Victoria amazonica* and *Eichornia crassipes*, respectively, collected in Lago do Macaco.



Mapa 6: Mineradoras Industriais na Amazônia brasileira no Princípio do Século XXI

Au

Hg

Início:1550
Apogeu:1980

Tese de Doutorado Luiz Jardim de Moraes Wanderley

GEOGRAFIA DO OURO NA AMAZONIA BRASILEIRA:

uma análise a partir da porção meridional

Hg naturalmente presente no solo amazônico?

SCIENTIFIC CORRESPONDENCE

Mercury pollution from deforestation

SIR — High mercury levels in the blood of fish-eating people in the Amazon have been attributed to gold mining activities conducted by informal miners. However, the high deforestation rate in the region has not been recognized as contributing to this environmental problem. About 90 tonnes of organic mercury from the biomass are estimated to be emitted annually to the atmosphere and precipitated in the aquatic systems for rapid transformation into methylated forms. This is a conservative assessment and may be more than six times this rate.

ESTIMATED Hg EMISSIONS FROM THE AMAZONIAN BIOMASS DURING DEFORESTATION

Biomass	Average (tonnes per ha)	Hg (p.p.m.)	Hg release efficiency (%)	Hg released (g per ha)
Above-ground wood	260	0.05	90	11.7
Above-ground leaves	9	0.05	90	0.4
Above-ground roots	20	0.05	90	0.9
Below-ground roots	35	0.05	20	0.4
Fallen trunks	16	0.05	90	0.7
Humus	11	0.3	20	0.7
Soil organic matter	47	0.3	20	2.8
Total	398			17.6

main diet in these communities, and about 90% of the Hg in fish is methylated[4].

Mercury has an affinity for organics in soil; raw humus ranges from 0.2 to 1.9 p.p.m. Hg[5]. Our analysis of 0.8 p.p.m. Hg in fulvic acid isolated from an non-mineralized and uncontaminated soil p.p.m.[11], whereas crops grown in soils containing less than 0.04 p.p.m. Hg vary from 0.004 to 0.09 p.p.m.[12]. Little is known about Hg distribution in the Amazon flora but aquatic macrophyles show levels between 0.1 and 1.0 p.p.m.

The temperature range encountered in

NATURE · VOL 368 · 28 APRIL 1994

ELSEVIER

The Science of the Total Environment 275 (2001) 71–82

the Science of the Total Environment
An International Journal for Scientific Research into the Environment and its Relationship with Man

www.elsevier.com/locate/scitotenv

Is the Negro River Basin (Amazon) impacted by naturally occurring mercury?

P.S. Fadini[a], W.F. Jardim[b,*]

Hg na Amazônia

Exploração de ouro

(Martinelli, 1988)

Natural no solo

(Veiga, 1994)

Hg inorgânico entra no sistema aquático

Metilado (bacterias)

MeHg

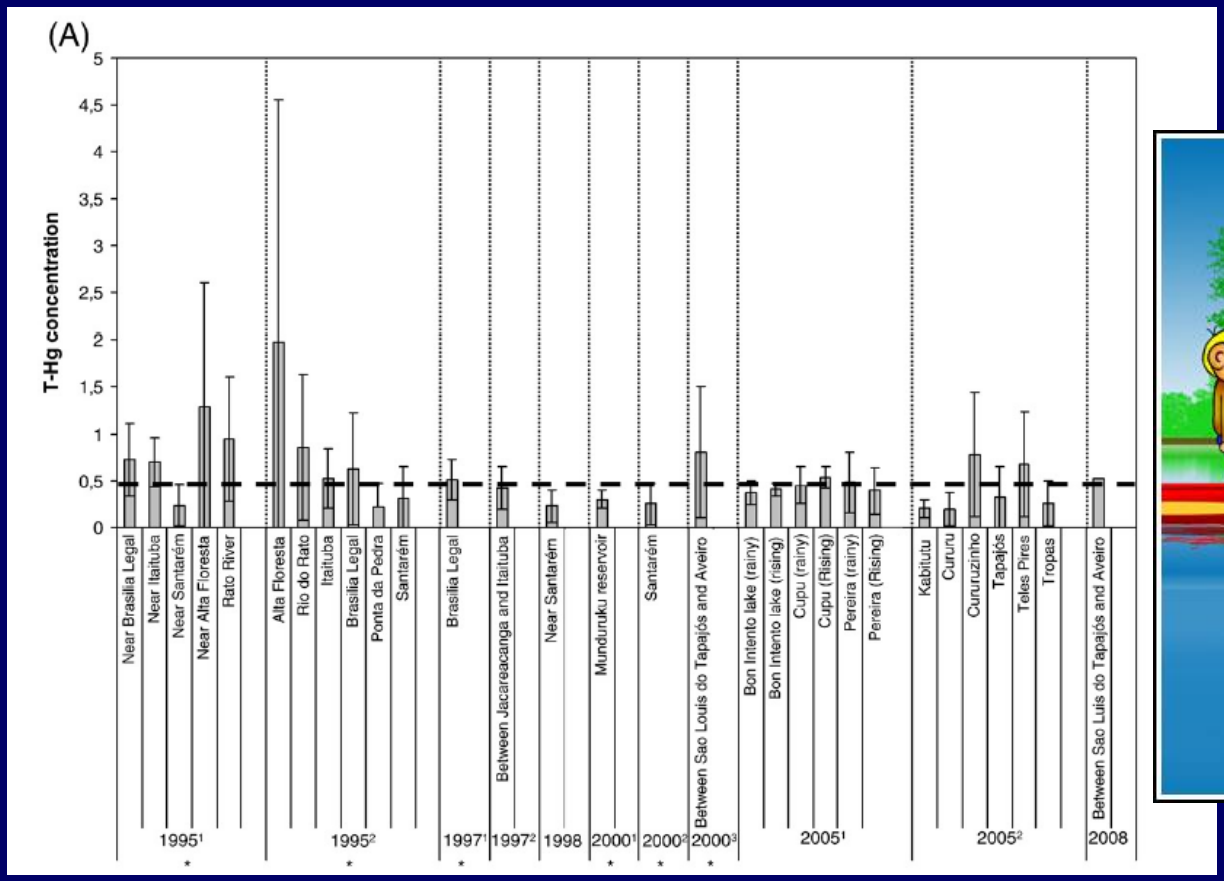
Acúmulo em peixes **(Guimarães et al., 1999)**

<u>Peixe- Dieta básica de população ribeirinha</u>

(Dolbec et al, 2001; Passos & Mergler, 2008)

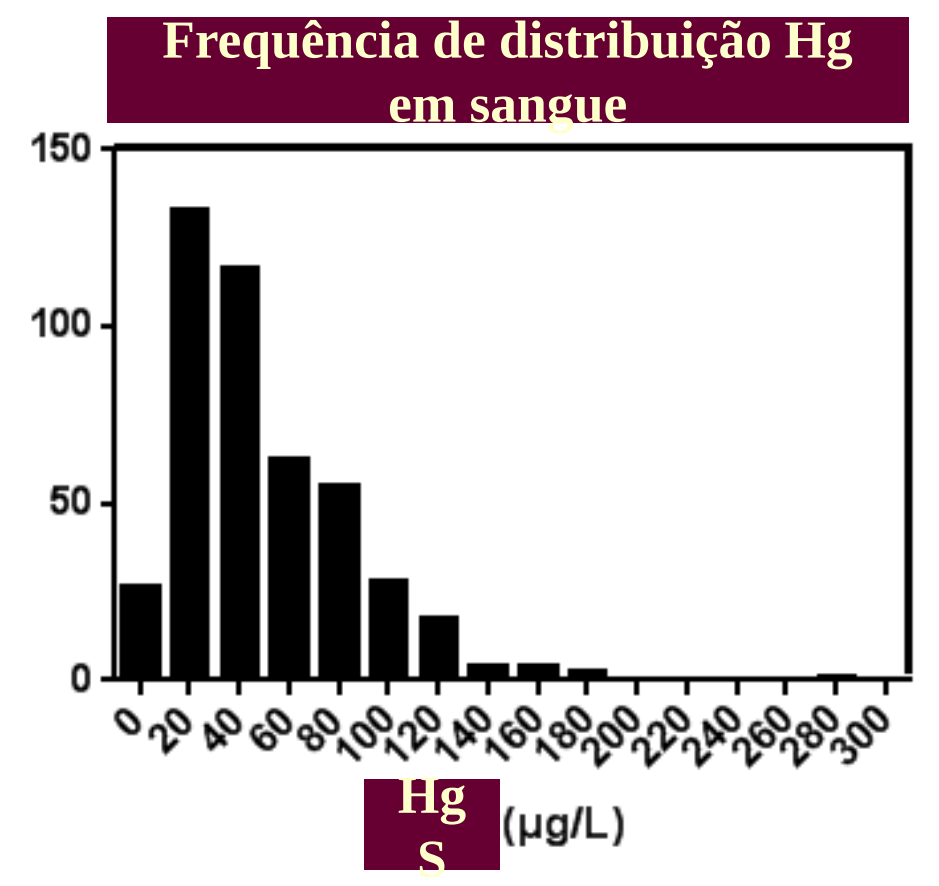
Elevadas concentrações de MeHg nos peixes

(Berzas-Nevado et al, 2010)



PORTARIA Nº 685, DE 27 DE AGOSTO DE 1998 (ANVISA)
MERCÚRIO
Peixes e produtos da pesca (exceto predadores) 0,5 mg/kg Hg
Peixes predadores 1,0 mg/kg Hg

Hg no sangue (HgS)



(HgS)
Média=49,6 µg/L
Mediana= 41,1
(variação: 3,5-288,9 µg/L)

HgS-IV National Report on Human Exposure to Environmental Chemicals, 2013
NHANES: (MG, 20-60 anos, em µg/L): 1,04 (,956-1,14). Em SP, os valores de referencia estão em torno de 1 µg/L)

Efeitos tóxicos: primeiras evidências

Neurotoxic Effects of Low-Level Methylmercury Contamination in the Amazonian Basin

Jean Lebel, *,[1] Donna Mergler, * Fernando Branches,† Marc Lucotte,‡ Marucia Amorim,§ Fabrice Larribe, * and Julie Dolbec *

ENVIRONMENTAL RESEARCH, SECTION A **79**, 20–32 (1998)

Environmental Health Perspectives ▪ Volume 107, Number 7, July 1999
Children's Health Article

Methylmercury Neurotoxicity in Amazonian Children Downstream from Gold Mining

Philippe Grandjean,[1,2] Roberta F. White,[1,2] Anne Nielsen,[1] David Cleary,[3] and Elisabeth C. de Oliveira Santos[4]