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Preface

The Transdisciplinary Research on Environmental Problem in Southeastern Asia (TREPSEA) international conference was started in 2011 by the 1st International Seminar of Environmental Geoscience (ISEGA) to provide a forum for its members to discuss and share their latest research. In 2014, the conference name was changed to 1st TREPSEA and it took place in Swiss Belinn Hotel, Makassar, Indonesia on 4-5 September 2014. The last but not the least conference is the current 2nd TREPSEA, which was held in the Papandayan Hotel Bandung, West Java with the great theme of "Disaster and Environmental". Our community is leading the way in studies to understand how to solve the environmental problems in Southeast Asia using Transdiciplinary approaches.

The 2nd TREPSEA collected 63 papers handed by colleagues from university, researcher and professional. All papers are divided into 4 main themes: Disaster mitigation, Measure and Improvement to Urban Environmental problem, Sustainable development and Environmental Preservation, and General. From 63 abstracts the committee selected 34 manuscripts to handle as Post Proceeding TREPSEA.

The chairman would like to express deep appreciation to the 3 universities, Bandung Government city for support to this event, and 2 conference sponsor companies. The 3 universities are Bandung Institute of Technology (ITB), Ehime University (EU), and State of Gorontalo University (UNG). The 2 companies include Medco Energy and PT. LAPI ITB.

The transdisciplinary research is defined as research efforts conducted by researchers from different disciplines and non-academic stakeholders working jointly to create new conceptual, theoretical, methodological, and translational innovations. The stakeholders are funder, government and development organizations, businesses and industries, civil societies (inhabitants, NGO's etc), and media for completion of the environmental problems. We look forward to cooperate with all of you to produce a deep, thoughtful set of works that can guide our activities in the future.

Chairman Prof. Dr Emmy Suparka

Acknowledgement to Sponsor of TREPSEA 2016

On behalf of committee members and participant, the chairman would like to express deep appreciation to the sponsor companies that have helped us to keep down the cost of TREPSEA 2016 for all participants. 1. Medco Energy

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Table of contents

Volume 71 2017

◆ Previous issue Next issue ▶

2nd Transdisciplinary Research on Environmental Problems in Southeast Asia 20–22 September 2016, Bandung, Indonesia

Accepted papers received: 07 June 2017 Published online: 20 June 2017

Open all abstracts

Preface

OPEN ACCESS			011001
2nd Transdisciplin	nary Research on E	Environmental Problems in Southeast Asia	
+ Open abstract	View article	PDF	
OPEN ACCESS			011002
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	View article	PDF	
Disaster Mitiga	tion		
OPEN ACCESS			012001
Tsunami Evidence of Cilacap	e in South Coast Ja	va, Case Study: Tsunami Deposit along South Coast	
Yan Rizal, Aswan, Y	Yahdi Zaim, Wahyu D	wijo Santoso, Nur Rochim, Daryono, Suci Dewi Anugrah, Wija	iyanto,
Indra Gunawan, Tat	ok Yatimantoro, Hida	yanti, Resti Herdiyani Rahayu and Priyobudi	
	View article	PDF	
OPEN ACCESS			012002
Tephra Fallout Ha Using TEPHRA2	azard Assessment for	or VEI5 Plinian Eruption at Kuju Volcano, Japan,	
Tomohiro Tsuji, Mic	chiharu Ikeda, Hiroshi	i Kishimoto, Koji Fujita, Naoki Nishizaka and Kozo Onishi	

+ Open abstract 🔄 View article 🔁 PDF

OPEN ACCESS Comparison land in South Bandung	slide-triggering rain g area	nfall threshold using satellite data: TRMM and GPM	012003
Gian Nanda Pratam	a, Rusmawan Suwarm	nan, I Dewa Gede Agung Junnaedhi, Edi Riawan and Aan Anug	grah
	View article	🔁 PDF	
OPEN ACCESS Identifying Succe	essive Eruption of C	Guntur Volcanic Complex Using Magnetic	012004
Asen Saepuloh and	Erwin Bakker	nene Aperture Radar (POISAR) Data	
+ Open abstract	View article	🄁 PDF	
-			
OPEN ACCESS Tidal inundation data and from ins	("Rob") investigationstitu measurements	on using time series of high resolution satellite image along northern coast of Java (Pantura)	012005
Heri Andreas, Usriy	yah, Hasanuddin Zaina	al Abidin and Dina Anggreni Sarsito	
	View article	🔁 PDF	
OPEN ACCESS Morphometric an Java, Indonesia Rahmi Mulyasari, F	nalysis of relative te Budi Brahmantyo and	ctonic activity in the Baturagung Mountain, Central Supartoyo	012006
+ Open abstract	View article	🔁 PDF	
OPEN ACCESS Impact of the 181 Achmad Djumarma	15 Tambora Eruptio Wirakusumah and He	on to global climate change eryadi Rachmat	012007
+ Open abstract	View article	PDF	
OPEN ACCESS Petrological stud Japan	ies of volcanic ash	from Sakurajima volcano in 2013, Southern Kyushu,	012008
Idham Andri Kurni	awan, Masayuki Sakal	kibara and Emmy Suparka	
+ Open abstract	View article	🔁 PDF	
OPEN ACCESS Sub Surface Geo Construction in S	electrical Imaging f Sidoarjo, East Java	for Potential Geohazard in Infrastructure	012009
Prihadi Sumintadire	eja and Diky Irawan		
+ Open abstract	View article	🔁 PDF	

Measure and Improvement to Urban Environmental Problem

OPEN ACCESS			012010
Analyses of surfa	ace deformation wit	h SBAR InSAR method and its relationship with	012010
aquifer occurrent	e in Surabaya City	, East Java, Indonesia	
Mushoddaq Mocha	mmad and Asep Saep	uloh	
+ Open abstract	View article	🔁 PDF	
OPEN ACCESS			012011
Groundwater and River	l solute transport m	odeling at Hyporheic zone of upper part Citarum	
Irwan Iskandar, He	ndy Farazi, Rahmat Fa	adhilah, Cipto Purnandi and Sudarto Notosiswoyo	
+ Open abstract	View article	🔁 PDF	
OPEN ACCESS			012012
A review on the environmental re	geoenvironmental a mediation in Vietna	and geoecological integrated technology for am: approaches, contributions, challenges and perspective	ves
Mai Trong Nhuan,	Nguyen Thi Hoang Ha	a, Ta Thi Hoai and Tran Dang Quy	
+ Open abstract	View article	PDF	
OPEN ACCESS			012013
Majalaya Flood I	Early Warning Syste	em: A Community Based Approach	
I Dewa Gede A Jun	naedhi, Edi Riawan, F	Rusmawan Suwarman, Tri Wahyu Hadi, Atika Lubis,	
Nurjanna Joko Trila	aksono, Rahmawati Ra	ahayu, PrawiraYudha Kombara, Riki Waskito, Hendra Ekalaya	Oktora,
Rahmat Supriatna,	Aan Anugrah, Abdul I	Haq Mudzakkir and Wawar Setiawan	
+ Open abstract	View article	PDF	
OPEN ACCESS			012014
Sediment trappin SWAT Model	g analysis of flood	control reservoirs in Upstream Ciliwung River using	
Mirwan Rofiq Gina	injar and Santosa Sanc	ly Putra	
+ Open abstract	View article	🔁 PDF	
OPEN ACCESS			012015
The Suitable Inde	ex of Flow and Den	sity in the Mixed Traffic	
Fadly Arirja Gani, 7	Toshio Yoshii and Shii	nya Kurauchi	
	View article	🔁 PDF	
OPEN ACCESS			012016
Economic feature Southeast Sulawe	es of the artisanal an esi, Indonesia	nd small-scale gold mining industry in Bombana,	

Basri, Masayuki Sakakibara and Ratnawati

OPEN ACCESS			012017
Ability of treated turbidity	kapok (Ceiba penta	andra) fiber for removal of clay particle from water	
Nurfitri Abdul Gafu	ır, Masayuki Sakakiba	ra and Mohamad Jahja	
	View article	PDF	
OPEN ACCESS Phytoremediatior Eleocharis acicul	n of arsenic- and mo aris in winter in Jap	blybdenum-contaminated alkaline wastewater by	012018
Shusaku Yamazaki,	Kenji Okazaki, Toshi	yuki Kurahashi and Masayuki Sakakibara	
	Tiew article	PDF	
OPEN ACCESS Investigation abo for the Solution to	ut Creation Possibi o Economical Pove	lity of Pearl Farming in North Gorontalo, Indonesia rty and Environmental Problem	012019
Hiroki Kasamatsu, I	Mohamad Jahja and M	Iasayuki Sakakibara	
	Tiew article	PDF	
OPEN ACCESS Development of a effects in travel n	discrete choice mod node choice context	lel considering internal reference points and their	012020
Sarif, Shinya Kurau	chi and Toshio Yoshii		
+ Open abstract	Tiew article	🔁 PDF	
Sustainable De	velopment and E	Environmental Preservation	
OPEN ACCESS Identification of A Exploration in a	Altered Minerals Ba Fropical Area	ased on Synthetic Aperture Radar (SAR) For Mineral	012021
Panggea Ghiyats Sa	brian, Asep Saepuloh	, Syafrizal and Arie Naftali Hawu Hede	
	View article	🔁 PDF	
OPEN ACCESS The removal of h	eavy metals by iror	n mine drainage sludge and Phragmites australis	012022
Nguyen Thi Hoang	Ha and Bui Thi Kim A	Anh	
+ Open abstract	View article	PDF	

+	Open abstract	View article	2
	I loop obstroat		
_	I men anstract		
	VIIVII austraut		0
	1		

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Mercury Distribution in the Processing of Jatiroto Gold Mine Wonogiri Central Java Indonesia

Dwi Fitri Yudiantor	ro, Muhammad Nurcho	olis, Dewi Sri Sayudi, Mirzam Abdurrachman, Intan Paramita I	Haty,
Wiryan Pambudi ar	nd Arum Subroborini		
+ Open abstract	View article	PDF	
OPEN ACCESS			012024
Regional geocher studies	mistry Bandung Qu	adrangle West Java: for environmental and resources	
Purnama Sendjaja a	and Baharuddin		
+ Open abstract	View article	🔁 PDF	
OPEN ACCESS			012025
Heavy metals acc	cumulation by Athy	rium yokoscence in a mine area, Southwestern Japan	
Hendra Prasetia, M	asayuki Sakakibara, A	kinari Takehara and Yuri Sueoka	
+ Open abstract	View article	🔁 PDF	
OPEN ACCESS An Artificial Cha Using Eleocharis	annel Experiment fo	or Purifying Drainage Water Containing Arsenic by	012026
Kenji Okazaki, Shu	saku Yamazaki, Toshi	yuki Kurahashi and Masayuki Sakakibara	
+ Open abstract	View article	🔁 PDF	
OPEN ACCESS Socio-demograph Sulawesi, Indone	nic characteristics o esia	f traditional gold smelters in Makassar, south	012027
A Open abstract	View article		
• Open abstract			
OPEN ACCESS Heavy metals con Gorontalo Utara	ncentrations in scal regency	o hairs of ASGM miners and inhabitants of the	012028
Yayu Indriati Arifir	n, Masayuki Sakakibar	a and Koichiro Sera	
+ Open abstract	View article	🔁 PDF	
OPEN ACCESS Corporate social of mining compa	responsibility for re ny in Indonesia	egional sustainability after mine closure: a case study	012029
Andi Erwin Syarif	and Tsuyoshi Hatori		
+ Open abstract	View article	🔁 PDF	
OPEN ACCESS			012030

Hydrothermal alteration and timing of gold mineralisation in the Rumbia Complex, Southeast Arm of Sulawesi, Indonesia

Musri Mawaleda, Emmy Suparka, Chalid Idham Abdullah, Nurcahyo Indro Basuki, Marnie Forster, Jamal and Kaharuddin

+ Open abstract 🔄 View article 🏷 PDF

General Sessio	n		
OPEN ACCESS			012031
Late Miocene Mo	olluscan Stage of Ja	wa Insight from New Field Studies	
Aswan, Elina Sufia	ti, Desty Kistiani, Irma	an Yudi Abdurrahman, Wahyu Dwijo Santoso, Alfend Rudyawa	an and
Thaw Zin Oo			
	View article	🔁 PDF	
OPEN ACCESS	- 1 AV 1		012032
Dermaji Village,	Study of Halang Fo Banyumas District,	rmation on Pangkalan River, Karang Duren – Central Java - Indonesia	
Yan Rizal, Raymon	d Lagona and Wahyu	Dwijo Santoso	
+ Open abstract	View article	PDF	
OPEN ACCESS Paleoenvironmen	ntal Study of Mioce	ne Sediments from JTB-1 and NRM-1 wells, in West	012033
Ogan Komering	Block, Meraksa Are	ea, South Sumatra Basin	
Aswan, Mirzam Ab	odurrachman, Bayu Sa	pta Fitriana, Mohamad Fery Mustofa, Wahyu Dwijo Santoso,	
Alfend Rudyawan,	Windy Dwi. Rahayu, A	Ahmad Hamdani, Yepi Rohiman and Thaw Zin Oo	
+ Open abstract	View article	🔁 PDF	
OPEN ACCESS			012034
Geochemical stud	dy of pyroclastic ro	cks in Maninjau Lake, West Sumatra	
Endang Wiwik Dya	ıh Hastuti		
+ Open abstract	View article	🔁 PDF	
JOURNAL LINK	XS		
Journal home			
Information for org	anizers		
Information for aut	hors		
Search for publishe	d proceedings		
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Heavy metals concentrations in scalp hairs of ASGM miners and inhabitants of the Gorontalo Utara regency

Yayu Indriati Arifin¹, Masayuki Sakakibara² and Koichiro Sera³ Published under licence by IOP Publishing Ltd

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Abstract

We performed the Particle Induced X-ray Emission (PIXE) analysis on scalp hair samples of 115 ASGM miners and inhabitants of Gorontalo Utara regency. Along with mercury (Hg), we presented other trace elements such as Copper (Cu) and Manganese (Mn). Concentrations of Cu, Mn and Hg in the scalp hairs of ASGM miners are higher non miners. Significant and positive correlations coefficients between Cu and Hg concentration with Mn concentration may indicate that there are still unknown metabolism process related with ASGM activities.



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Heavy metals concentrations in scalp hairs of ASGM miners and inhabitants of the Gorontalo Utara regency

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Abstract. We performed the Particle Induced X-ray Emission (PIXE) analysis on scalp hair samples of 115 ASGM miners and inhabitants of Gorontalo Utara regency. Along with mercury (Hg), we presented other trace elements such as Copper (Cu) and Manganese (Mn). Concentrations of Cu, Mn and Hg in the scalp hairs of ASGM miners are higher non miners. Significant and positive correlations coefficients between Cu and Hg concentration with Mn concentration may indicate that there are still unknown metabolism process related with ASGM activities.

1. Introduction

The Gorontalo Utara regency is home of the historical gold mining site Hulawa (formerly known as Buladu), the Hulawa reopen again at 1970 by local inhabitants and continues operates as ASGM. Since 2000 several new ASGM sites in the regency has been start operating. Recent estimation that ASGM sites in the regency produces 286 kg of gold and emits 572 kg of Hg per year [1]. Elevated mercury concentrations on the environments and human hairs of ASGM miners and inhabitants have been reported [2]. Arsenic (As) and lead (Pb) concentrations in human scalp hairs have been detected and positively correlate with mercury [3].

In this report, we presented the evidence of other trace elements (Cu and Mn) in scalp hair of miners and inhabitants of the Gorontalo Utara regency. Correlations of Cu and Mn with Hg in scalp hair may add information on source of contamination or fate of elements in human body.

2. Experimental

2.1. Study Area

Samples were collected from five districts in the Gorontalo Utara regency: Anggrek, Kwandang, Monano, Sumalata, and Tolinggula (Figure 1). Geographically, Tolinggula, Sumalata, Monano, Anggrek, and Kwandang are situated on hills and mountains along the coastline of the Gorontalo Utara Regency. Inhabitants of the Gorontalo Utara regency mainly work as farmers and fishermen. Marine fish is commonly a part of their diets, along with rice, corn and vegetables, which are also produced on the nearby hills alongside the coastline.

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Figure 1. Sampling locations of human hair from the Gorontalo Utara regency are indicated by (●) on Gorontalo Province map, Tolinggula, Sumalata, Anggrek, Monano and Kwandang are name of subdistricts.

The ASGM activities in the Sumalata and Anggrek districts are located along the Wubudu and Anggrek riverbanks, respectively. The bioaccumulation of Hg, which may occur in living organisms such as paddy rice, corn, and marine fish, becomes agents that spread Hg contamination through the food web of inhabitants in the Gorontalo Utara regency. The Hg concentration in river sediments and fish will be used as background information about the Hg in the biotic and abiotic environments.

The Sumalata and Anggrek districts are locations with ASGM activities, while Kwandang, Monano, and Tolinggula are districts without mining activities. The residents of Anggrek and Sumalata are considered the ASGM miners group, while the residents of Kwandang, Monano, and Tolinggula are considered the control group.

2.2. Sampling

Human scalp hair samples were taken from 95 participants from inhabitants of Anggrek (n=25), Sumalata (n=24) Kwandang (n=15), Monano (n=39), and Tolinggula (n=12) between 2012 and 2013. Of the 115 participants, 66 were female, and the mean age was 23 years (range: 8 months – 63 years). Among the 115 participants, 21 were ASGM workers, 22 were housewives, 7 were officers of the regency, 6 were unemployed, 1 was a teacher, 1 was a university student and 38 were children (participants with ages below 18 years old).

The Cu, Mn, and Hg concentrations in the hair samples from Anggrek, Kwandang, Monano, Sumalata, and Tolinggula were determined to understand the status of contamination. The distribution of participants according to sex, location, and occupation is summarized in the table 1. Approximately 10-20 strands of hair were cut close to skin from the right backside (mastoidal region of the temporal bone) and then labelled and stored in a sample plastic bag [5].

The Hg concentration in hair samples will be used to characterize the risk through a comparison with reference values published by the German Human Biomonitoring Commission in 1999 (Commission Human – Biomonitoring of the Federal Environmental Agency Berlin, 1999) [6]. The German Human Bio-Monitoring (HBM) commission established toxicology threshold limits, which can be put into three categories. The first category is below normal or HBM I, where the Hg level in hair is below 1 μ g/g. The above normal category is an alert level between HBMI and HBM II, where

the Hg hair content is from 1 to 5 μ g/g. Meanwhile, above 5 μ g/g is categorized into the high level or over HBM II. Cu and Mn are essential elements for human body, however at certain conditions their excess concentrations are related to disturbance in organ functionalities [7-9].

Residence	Sex	Ν	Job	Ν
Anggrek	F	13	Miner	8
88 -	М	12	Non Miner	17
	Total	25	Total	25
Kwandang	F	7	Miner	0
U	М	8	Non Miner	15
	Total	15	Total	15
Monano	F	24	Miner	1
	М	15	Non Miner	38
	Total	39	Total	39
Sumalata	F	12	Miner	12
	М	12	Non Miner	12
	Total	24	Total	24
Tolinggula	F	10	Miner	0
804	М	2	Non Miner	12
	Total	12	Total	12
Total	F	66	Miner	21
	М	49	Non Miners	94
	Total	115	Total	115

Table 1. Number of scalp hair donor distribution related to their job, sex and living place in Gorontalo Utara regency.

2.3. Analytical Procedure

Elemental analysis for the scalp hair samples was performed by particle induced x-ray emission (PIXE) in the Cyclotron Research Center, Iwate Medical University, Japan. The precision and accuracy of this method have been reported elsewhere [10-12] and will be described as follows. We used Zinc with known concentration (256 ppm) as internal standard; PIXE detects peak count of K_{α} about 2,325.2 ±50 (2% error). Hair samples were washed using Milli-Q water and shaken in an ultrasonic bath for 1 minute. Then, the samples were dried by wiping them with a tissue. The dried hair samples were washed again by being stirred in acetone for 5 minutes. Then, they were washed again using Milli-Q water, wiped well with tissue and left to dry at room temperature. The hair samples (approximately seven hairs per person) were stuck on a target holder. A 2.9 MeV-proton beam hit the target after passing through a beam collimator of graphite, whose diameter was 6 mm. Xrays of energy higher than that of the K- K_{α} line were detected by a Si(Li) detector (25.4 mm thick Be window; 6 mm active diameter) with a 300 mm-thick Mylar absorber. For measurements of X-rays lower than the K-K_{α} line, a Si(Li) detector (80 mm Be; 4 mm active diameter), which has a large detection efficiency for low energy X-rays, was used. Descriptions of the data acquisition system and the measuring conditions are reported elsewhere [8]. The typical beam current and integrated beam charge were 100 nA and 25 μ C, respectively. The procedure for the standard-free method for untreated hairs is almost the same as that reported in the previous studies [6].

3. Result and discussion

Table 2 shows the summary of statistical results of Cu, Mn, and Hg concentrations in hairs of the inhabitants in the Gorontalo Utara regency. There is clear indication that means concentrations of Cu, Mn and Hg for ASGM miners are higher than miners. But there were no clear trends of mean concentrations of Cu, Mn, and Hg as functions of distance of living place to ASGM locations.

We perform the Spearman correlation on the total sample, and we found the tree coefficients (see the Table 3). There are strong and significant correlations of Hg and Mn concentrations to Cu concentration in hairs of inhabitants of the Gorontalo Utara regency. While weak and non-significant correlation is found between Cu and Hg.

Dogion	Cu		Mn		Hg	
Region	Mean \pm SD	range	Mean \pm SD	range	Mean \pm SD	range
Anggrek	32.2±2.1	14.9-136.1	14.0 ± 2.6	1.3 - 56.7	16.9 ± 29.2	2.1 - 144.8
Kwandang	15.0±1.7	6.6 - 34.8	3.9 ± 5.7	0.4 - 103.4	6.5 ± 1.5	3.5 - 14.6
Monano	11.9±1.6	1.5 - 26.9	10.3 ± 2.7	0.9 - 63.8	5.6 ± 2.8	2.8 - 28.1
Sumalata	16.6 ± 1.5	6.2 - 45.7	4.5 ± 4.8	1.0 - 58.6	8.2 ± 1.9	2.5 - 69.8
Tolinggula	11.4±1.3	1.3 - 16.1	12.1±3.0	1.8 - 87.9	5.1 ± 0.8	4.3 - 6.0
Miners	22.6 ± 1.9	6.2 - 89.3	13.6 ± 1.7	1.6 – 136.1	8.2 ± 1.7	2.7 - 17.9
Non miners	13.6 ± 1.7	1.5 – 136.7	8.5 ± 3.4	0.4 - 88.0	6.3 ± 2.0	1.1 - 144.8
Total	1.3±2.7	0.0 - 19.9	8.7±10.4	0.0 - 67.6	10.2 ± 16.9	2.1-144.8

Table 2 . Cu, with, and fig concentrations (µg/g) in naiss of milabilants in the Obtomato Otara regene	Table 2.	Cu, Mn.	, and Hg concentration	s (µg/g) in hairs	of inhabitants in the	Gorontalo Utara regency
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Table 3. Correlation coefficient between elements.					
Element.	Mn		Hg		
Element	Coeff.	Sig.	Coeff.	Sig.	
Cu	0.12	0.06	0.14	0.15	
Hg	0.25	0.007			

4. Conclusion

Concentration of Cu, Mn, and Hg in average of miners and inhabitants of exposed group (Anggrek and Sumalata) are less elevated than control group (Kwandang, Monano, and Tolinggula). While according to HBM: inhabitants of the Gorontalo Utara regency have elevated Hg concentration (already in the alert level), while mean value for inhabitants exposed groups are in the danger level. The amount of Pb in hair of inhabitants of the Gorontalo Utara regency are still in the safe level, while As are already higher than the limit.

We also found the significant and strong correlation between concentrations of Cu and Hg to Mn in scalp hairs of inhabitants of the Gorontalo Utara regency. Such correlation may reveal the unknown sources of contamination, routes of contamination, and impact on health status of individual hair donors.

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